NOVEMBER 1958

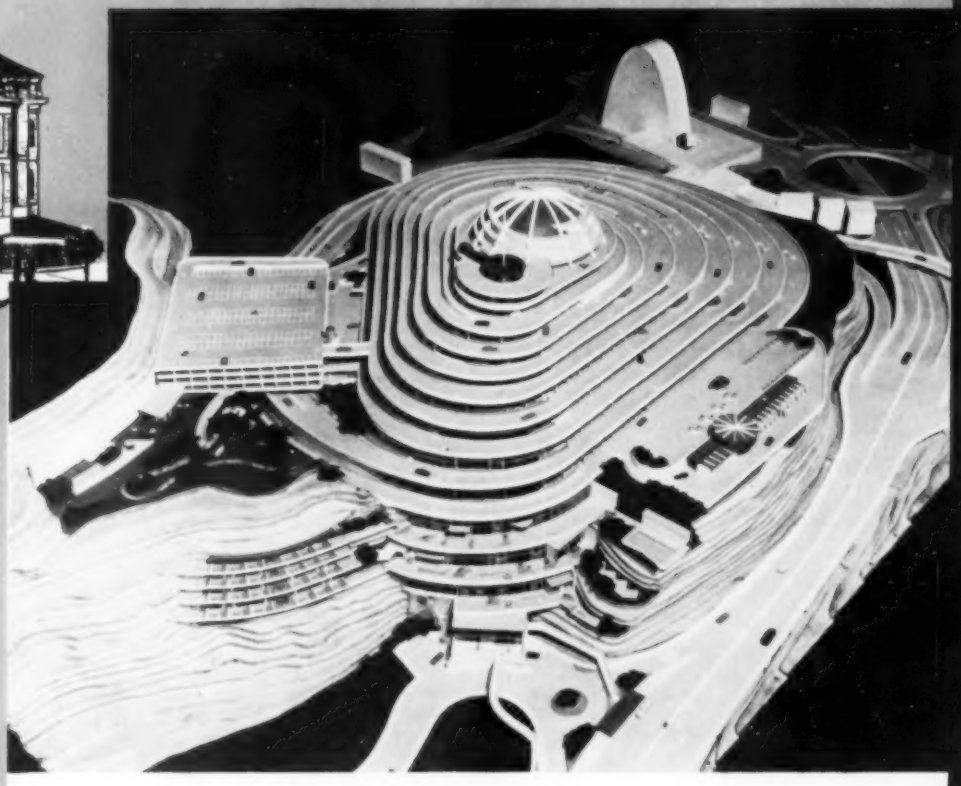
Brick & Clay Record

LEADING CLAY JOURNAL OF THE WORLD

BRICK • REFRACTORIES • STRUCTURAL TILE • SEWER PIPE • DRAIN TILE • TERRA COTTA • ROOFING TILE • CLAY AGGREGATE

SPECIAL: CLAY MODIFIERS ISSUE

A special section of supplies and materials that can improve your product, lower your operating costs, help solve your production problems.



Overlooking Caracas, Venezuela, this "spiral in space" will be ready for use in 1960; built at an estimated cost of $25,000,000. It is 10 stories high on one side, 25 on the other—covers 25 acres of mountainside. It will include 320 stores, hotel, swimming pool, children's park, 7 theaters, business offices, garages, its own closed TV circuit and in the dome, a Great Hall for International Trade Fairs. Architect Sr. Jorge Romero Gutierrez makes skillful use of clay products in his dazzling white "Helicoid."

PHOTO COURTESY HAMILTON WRIGHT

Bonnot.....PACES PROGRESS

to assure....PRODUCTS

that insure..PROFITS

From brick for leading buildings many decades ago (produced in the very first Bonnot extrude
. . . to clay units for the super-modern "flying saucer" business center in South America . . . Bonn
engineering paces the industry with processing equipment that provides products to meet the mo
exacting specifications of their time.

Such "specifications" include precision brick and tile. But more importantly, right now, the
must be machine room performance that safeguards profits by assuring *"maximum productio
at minimum cost."*

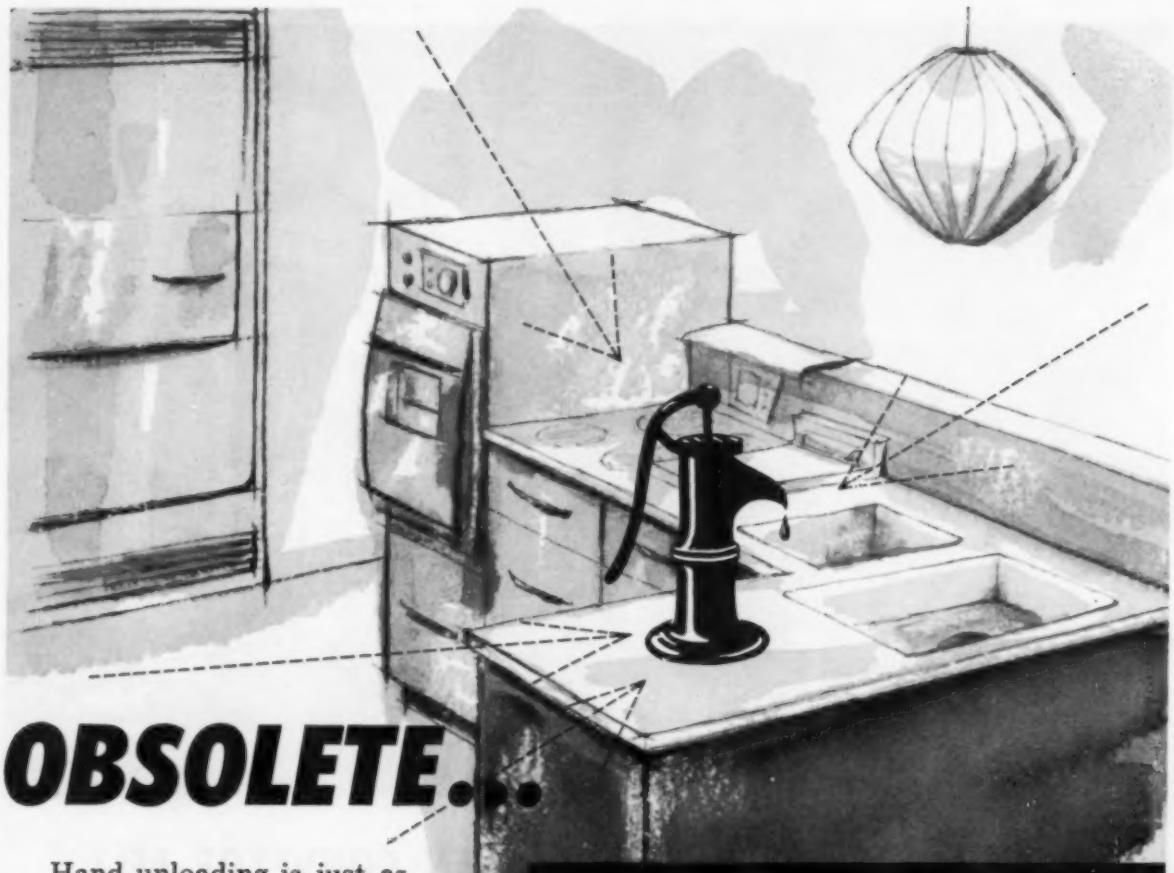
Raw material to manufacturing—whatever your toughest production problems, Bonnot's advance
engineering is available . . . in your plant or our Canton Laboratory. Your inquiry gets promp
experienced action at Bonnot. And without obligation. You're invited to call or write toda

CRUSHERS
HAMMER MILLS
DRY PANS
WET PANS
GRINDERS
FEEDERS
CUTTERS
REPRESSES
DIES
MIXERS
PUG MILLS
AUGER MACHINES
VACUUM MACHINES
SPECIAL EXTRUDERS
SPECIAL MACHINES TO ORDER
DIRECT FOUNDRY SERVICE

STEP AHEAD WITH BONNOT

The BONNOT Co.

CANTON 2, OHIO



OBSOLETE...

Hand unloading is just as obsolete.

There's no place in a modern kitchen for an old-time hand pump . . . there's no place in a modern mechanized operation like yours for the wasteful inefficiency of hand unloading, or for that matter, slow hand-operated unloading devices.

SUPERLITE UNLOADERS speed deliveries; quickly pay for themselves by fast gentle handling. Proved and approved under all conditions, SUPERLITE UNLOADERS can be used on any flat bed truck or trailer regardless of length.

If you WANT to cut delivery costs 50% or more, contact us at once, by letter, wire or telephone. Collect calls cheerfully accepted.

Effortless SUPERLITE UNLOADING
Fast - Economical - Practical

BUILDERS EQUIPMENT COMPANY

3810 NORTH CENTRAL AVENUE
PHOENIX, ARIZONA
Telephone Numbers:
CRestwood 4-8321
CRestwood 4-8431

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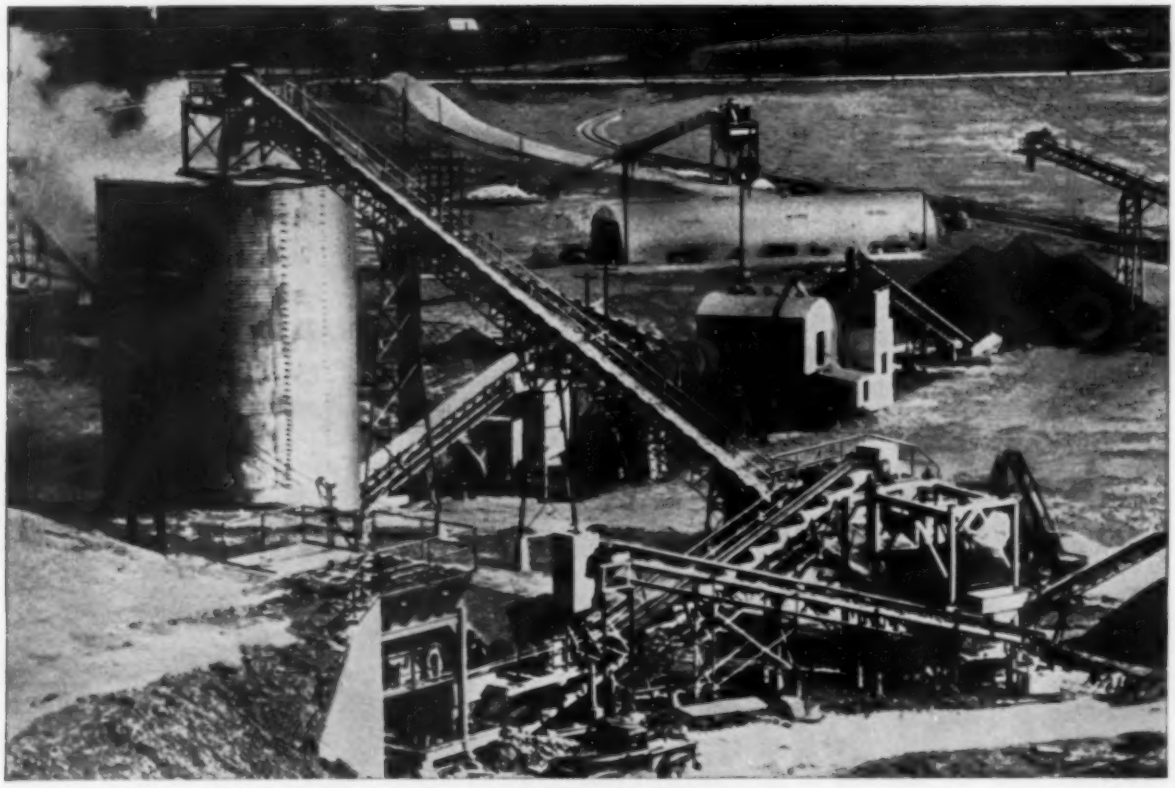

R/M Puts Extra Life in RAY-MAN CONVEYOR BELT

. . . Gives You "More Use ~~per~~ for Your Dollar"

Every feature of the conveyor belt you use to handle brick, clay and other bulk materials — belt troughability, resiliency, fastener holding ability, strength member fabric, cover toughness and thickness — help determine the *real* cost of that belt on your job. That's why R/M engineers have precision proportioned every component part of Ray-Man Conveyor to assure better belt balance where it can pay off most for you — in longer belt service life!

Elastic cushioned strength member plies made of strong, natural and synthetic fabrics give this belt amazing resiliency and flexibility to trough easily and train naturally. Compensated, balanced construction relieves stress on the outer plies of the belt to give Ray-Man exceptional fastener holding ability *without* a breaker strip. R/M's exclusive "XDC" Cover adds a degree of protection against wear, tear, cuts and abrasions never before possible. Like all R/M heavy duty conveyor belts, Ray-Man is mildew-proof and moisture resistant.

Ray-Man Conveyor Belt cuts your handling costs because it's *engineered* to do a better job . . . and to *last longer.*

Let an R/M representative show you the advantages of Ray-Man as well as other R/M conveyor belts. He'll help you select the one with extra life for your job . . . More Use for Your Dollar. Write for Bulletin 6915.

RM 655

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

Brick & Clay Record

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BRICK & CLAY RECORD
5 S. Wabash Ave. Chicago 3, Ill.

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A special section of supplies and materials that can improve your product, lower your operating costs, help solve your production problems. Categories include coloring agents, deflocculants, fluxes, body conditioners, others.

Stark Ceramics 40
Company has added their first tunnel kiln with output increase of 20%; three unit plant.

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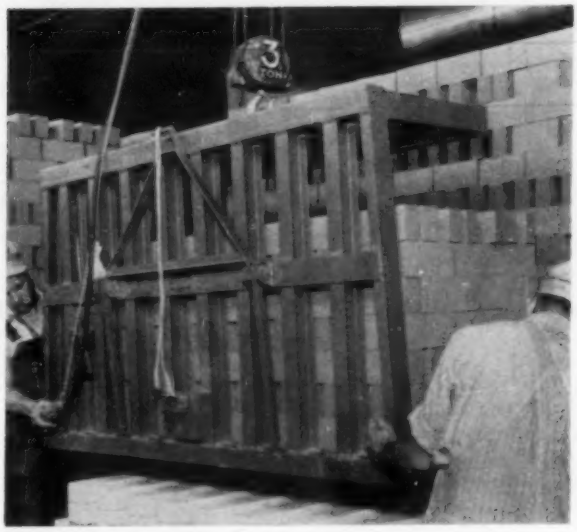
When renewing your subscription to BRICK & CLAY RECORD, it is a good policy to buy on the thrifty 3 year basis. In effect you get one year free.

BRICK & CLAY RECORD
5 South Wabash Chicago 3, Ill.

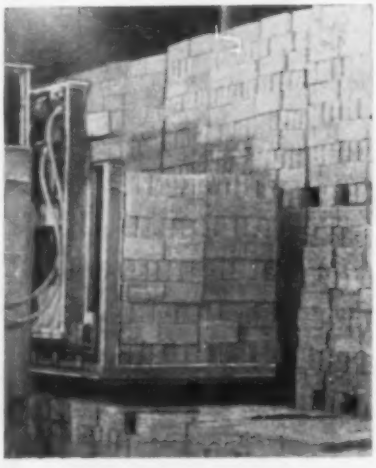
Make Brick Handling Easy . . .



PRIESTER Brick Forks

- **Save Time**
- **Save Money**
- **Save Labor**

Also Priester truck cranes for unloading from delivery trucks. Write for bulletin.



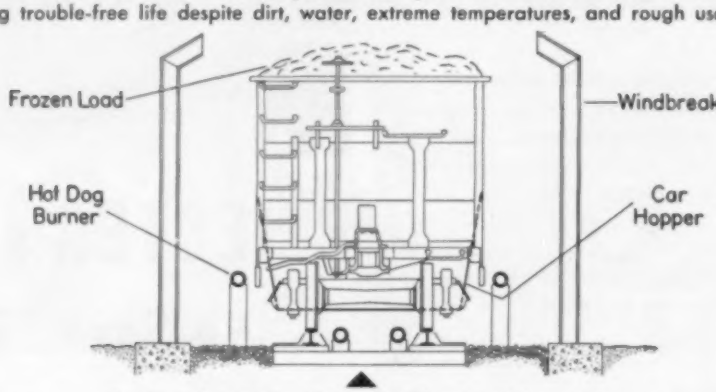
Brick in units of any size are handled by Priester Brick Forks. Automatic operation simplifies and speeds brick handling setting and drawing kilns, loading and unloading trucks and box cars.

Forks with flap grippers for cored and solid brick. Give service . . . take the hard work out of brick handling. Write today for more information.

BRADNEY MACHINE CO., INC.
Middletown, New York

CAR THAWING UNITS
by NORTH AMERICAN

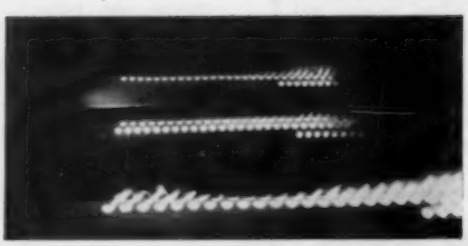
"Hot Dog" Car Thawing Units include a perforated alloy radiant tube, burner, and valves. They heat both bottoms and sides of hopper cars efficiently by both radiation and convection. Note the simple but heavy cast iron construction that assures long trouble-free life despite dirt, water, extreme temperatures, and rough usage.



Suggested positions of four Car Thawing Units, windbreaks, piping, and controls, relative to a hopper car.

"Hot Dog" Car Thawing Units are located between the tracks at track level and 3' outside each rail just above the journals.

Car Hopper in Position over Perforated Radiant Tubes. Journal bearings (right) do not become overheated.

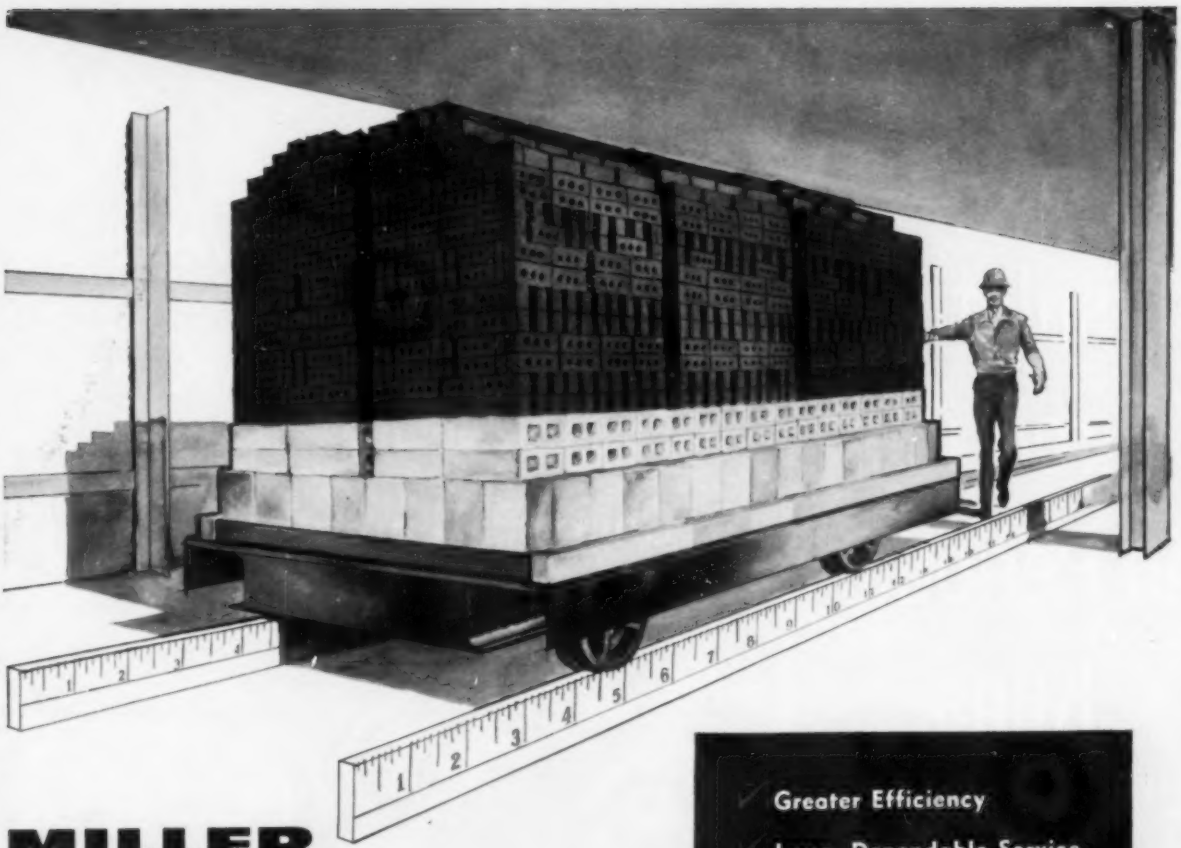


Three "Hot Dogs" in Operation. Note rails between first and second and beyond third tube.

For engineering information consult your nearby N.A. office or write for Bulletin 5854.

The North American Manufacturing Co.
COMBUSTION ENGINEERS
CLEVELAND 5, OHIO

58.54



MILLER

Kiln Cars Measure Up To Your Specifications!

- ✓ Greater Efficiency
- ✓ Long, Dependable Service
- ✓ Smooth, Easy Maneuvering
- ✓ Heavy-duty Operation

Put your kiln car requirements on a yardstick scale. Miller-built kilh cars really measure up because they're designed from **your** specifications to fill **your** individual needs.

Miller Equipment Company is the only manufacturer that maintains **complete** tunnel kiln and kiln car facilities. Miller engineers design, build, and service kiln cars for every type of installation, large or small.

Miller kiln cars feature lightweight, yet sturdy, all-welded construction. Equipped with Timken Tapered Roller bearings, 2 units per wheel, Miller cars are easily moved by one man.

Write Miller Equipment Company today! Our engineers will analyze your needs and give you full information and prices, without obligation.

Miller Equipment Company

CROS-FLO TUNNEL KILNS
HAMMERMILL CRUSHERS
CONVEYOR EQUIPMENT
ENGINEERING SERVICE

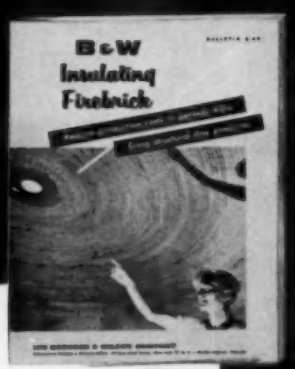
P. O. Box 1566 • Phone ME 3-3541 • Salisbury, N. C.

Southwestern Agent:
A. K. MOULTON ASSOCIATES
6936 San Pedro Avenue
San Antonio 12, Texas

Pacific Agent:
WALTER C. STOLL & SONS
5028 Alhambra Avenue
Los Angeles 32, California

Why B&W Insulating Firebrick in Periodic Kilns ?

- Lightest Weight
- Lowest Thermal Conductivity
- High Fuel Savings
- Faster Cycling
- Uniform Temperatures
- Simplified Construction



Since B&W IFB are lighter than other insulating firebrick, they insulate better. Thus, they save more fuel.

The lighter weight of B&W Insulating Firebrick provides low thermal conductivity and lower heat storage. As a result, the kilns heat and cool more quickly, thereby appreciably increasing production. B&W IFB also aid in reducing rejects by maintaining uniform temperatures within the kiln.

B&W IFB are further suited for use in periodic kilns because their light weight, high hot-load strength and negligible shrinkage permit thinner, less costly wall constructions. In addition, B&W IFB are easier to shape and handle . . . make construction and maintenance simpler.

For information on how lightweight B&W Insulating Firebrick can increase production and cut costs in your kilns, consult your local B&W Refractories Representative or write for Bulletin 609.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS:
B&W Alumul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick
B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide • B&W Ramming Mixes • B&W Kaowool

R-609

keep costs down with "International" equipment Modern as tomorrow

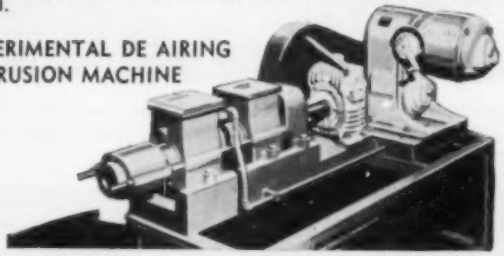
INTERNATIONAL DRY PRESS at Gladding-McBean plant, Mica, Wash.

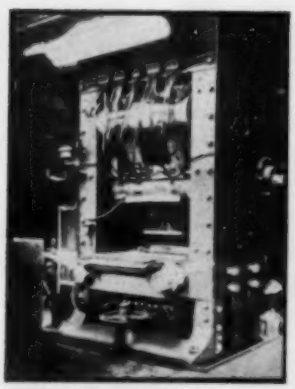
EQUIPMENT FOR THE CERAMIC & ELECTRONIC INDUSTRIES—WALL TILE—SANITARY WARE — ELECTRIC PORCELAIN CHINAWARE AND ELECTRONICS

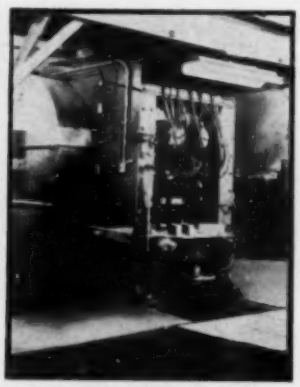
FREE BOOKLETS

DESCRIBING NEW ECONOMIES and Equipment in Clay Working and Ceramic Machinery—Send for these Free Books today, indicating your preference by Number — BRICK, TILE AND HOLLOW BLOCK MACHINERY, No. 63 — REFRACTORY PRESSES, No. 66A — PEBBLE AND BALL MILLS, No. 100 A & B—LABORATORY AND EXPERIMENTAL EQUIPMENT, No. 77A — CERAMIC MIXING AND EXTRUSION MACHINERY, No. 62B—PORTABLE MIXERS, No. 74—AGITATORS, No. 83.

EXPERIMENTAL DE AIRING EXTRUSION MACHINE

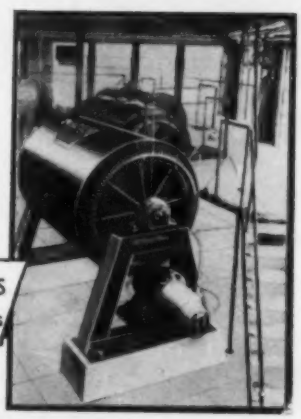




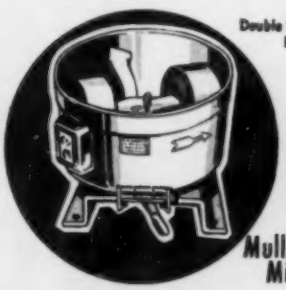


INTERNATIONAL DRY PRESSES at Gladding-McBean plants, in Pittsburg, Cal., and Renton, Wash.

icm



PEBBLE & BALL MILLS
Batch & Continuous Types



Double Stirrer Blungers

Muller Mixers

International
CLAY MACHINERY CO. DAYTON 1, OHIO

NEW YORK
15 Park Row—WO-rth 2-2580

BAldwin 3-7275

Freeport Brick Co. Plant, Freeport, Pennsylvania. Dimensions: 640'x 100'x 22'.
Architects, Engineers and General Contractor: Freeport Brick Co.

Sub-Contractor for Roofing and Siding: Callery Industries, Inc.
130 Hillvue Lane, Pittsburgh 37, Pennsylvania.

A KAISER ALUMINUM ROOFING & SIDING SHEET TO SUIT YOUR NEEDS

Ribbed Siding

Thickness: 0.032" and 0.040"
Length: 5' to 22' in 6" increments and 22' 5"
Width: 41⅛" overall
Rib Configuration: 1" deep — 4" and 8" pitch
Finish: Stucco Embossed

Also available with rib configuration 1½" deep — 5.33" pitch. Sheet thickness 0.032". Lengths 5' to 12' in 6" increments. Other specifications on request.

V-Beam Roofing & Siding

Thickness: 0.040" and 0.051"
Length: 5' to 22' in 6" increments and 22' 5"
Width: 41¼" overall
V Configuration: 1¼" deep — 8⅛" pitch
Finish: Stucco Embossed

Industrial Corrugated Roofing & Siding

Thickness: 0.024" and 0.032"
Length: 5' to 12' in 6" increments
Siding Width: 33⅛" and 47⅛" overall
Roofing Width: 35" and 48⅛" overall
Corrugation: ¾" deep — 2.67" pitch
Finish: Plain Mill and Stucco Embossed

Flat Sheet Roofing & Siding

Thickness: 0.024" and 0.032"
Finish: Plain Mill and Stucco Embossed

Full specifications on request.

NOTE: Kaiser Aluminum also offers a complete selection of flashing sheet, formed flashing, closures and other accessory building items.

NEW! INSULATED ALUMINUM "SANDWICH" WALLS

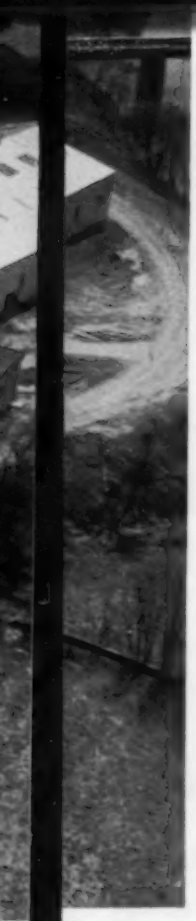
Choose From These and Other Sandwich Combinations

Inner Skin: 0.024" Industrial Corrugated Siding
Outer Skin: 0.032" Ribbed Siding—5.33" pitch

Inner Skin: 0.024" Industrial Corrugated Siding
Outer Skin: 0.032" Ribbed Siding — 4" pitch

Inner Skin: 0.024" Industrial Corrugated Siding
Outer Skin: 0.032" Ribbed Siding — 8" pitch

Inner Skin: 0.024" Industrial Corrugated Siding
Outer Skin: 0.032" Industrial Corrugated Siding



LONGEST LIFE LOW INITIAL COST!

Freeport Brick Company—one of today's foremost manufacturers of ladle brick—chooses corrosion-resistant Kaiser Aluminum roofing and siding for their new 64,000 square foot brick plant

The Pittsburgh area's corrosive climate can be murder on many building materials — and the Freeport Brick Company knew it.

So, before starting work on their new brick plant in Freeport, Pennsylvania, company president Francis H. Laube made an intensive study of all available materials — including aluminum and specially treated steel.

His purpose: to determine just which would best combine the benefit of minimum long range maintenance with low *initial* cost.

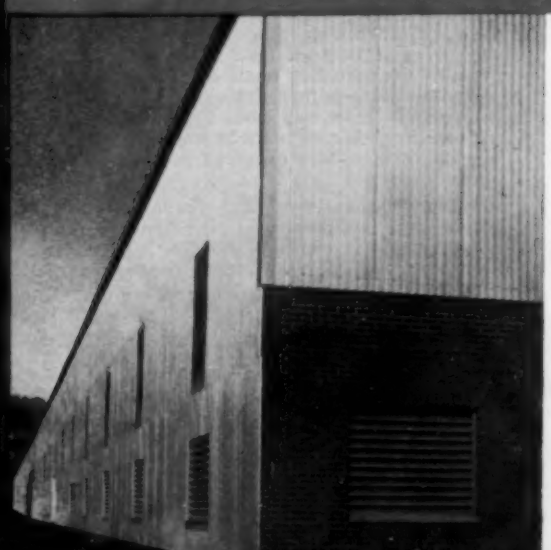
Result? Freeport specified corrosion-resistant sheets of Kaiser Aluminum—and is now looking forward to many years of economical service.

And Freeport got a bonus. Kaiser Aluminum's light weight — plus special design features — made big *installation* savings possible, too!

For example, sub-contractor David Starr of Callery Industries, Inc., a Kaiser Aluminum franchised applicator-erector, has this to say about their roofing work:

"We were very pleased with the way lightweight Kaiser Aluminum 48" corrugated sheets handled. Because of their extra width, fewer sheets were needed and there was considerably less waste from lapping. In fact, the entire 64,000 square feet were covered in only 15 days.

"For our money, nothing beats the benefits of Kaiser Aluminum industrial building products."



Attractive combinations of brick and functional Kaiser Aluminum box ribbed siding were employed for three walls of the plant. The fourth was hung exclusively in aluminum to allow for easy future expansion.

Kaiser Aluminum produces a full line of building products ideally suited for the brick and clay industry.

Weighing two-thirds less than similar steel materials, they speed construction and reduce the need for heavy, expensive supporting structurals. Their unique combination of strength and corrosion resistance promises a lifetime of handsome service with little necessity for painting or other care. And their distinctive embossing adds to the appearance of the building plus giving greater glare diffusion.

For A.I.A. File and full information, contact the Kaiser Aluminum sales office listed in your telephone directory. Or write Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office,* Palmolive Bldg., Chicago 11, Ill.; *Executive Office,* Kaiser Bldg., Oakland 12, Calif.

KAISER ALUMINUM

THE BRIGHT STAR OF METALS

See "MAVERICK" Sunday evenings, ABC-TV Network. Consult your local TV listing.

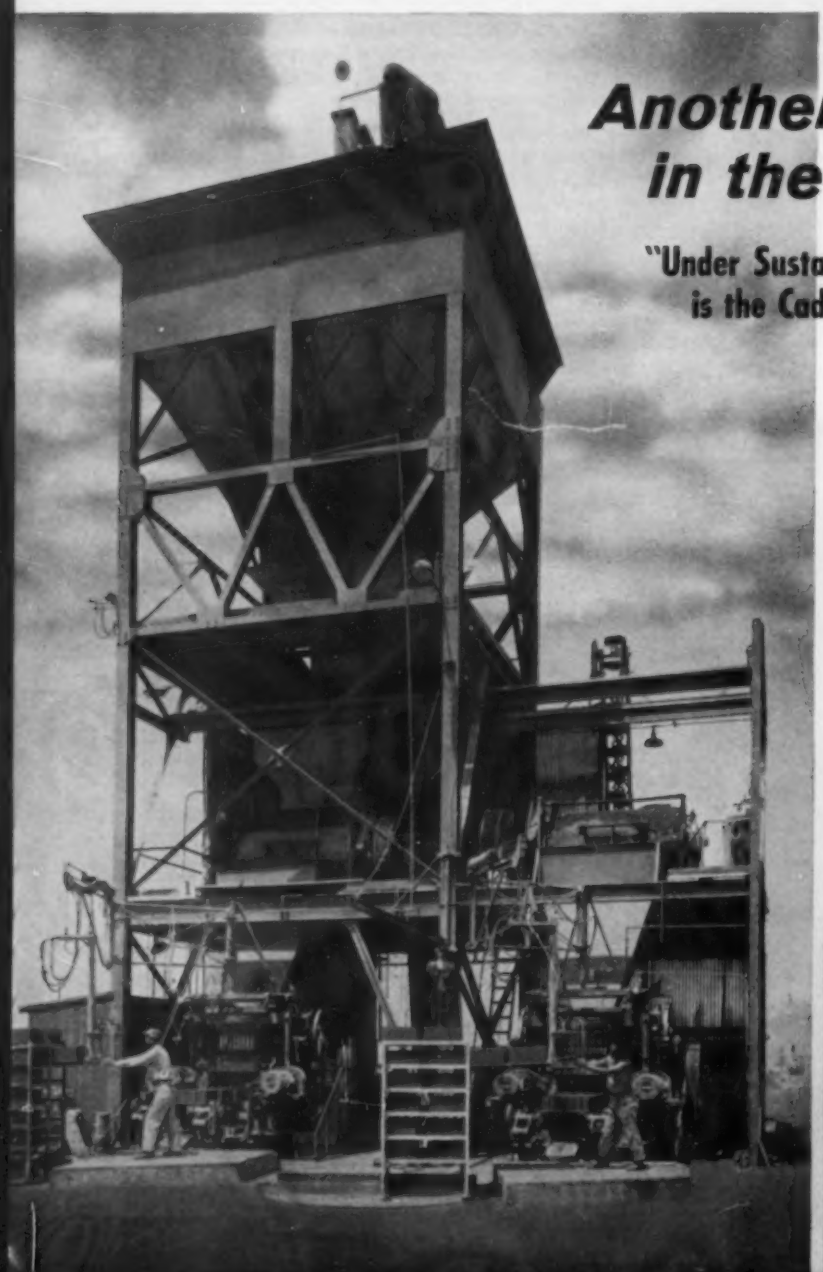
• Executives of the B & G Concrete Manufacturing Co. (l to r) James B. Frank, Chief Dispatcher; Ivan W. Newport, Gen. Mgr.; Gladys R. Iliff, Vice Pres.; Bruce C. Iliff, President; and Walter Renfro, Sales Mgr.

• Aerial view of B & G Long Beach plant showing stock piles of block and kilns. Illustration below shows "open air" installation of two Vibrapac machines and two Besser 50 cu. ft. mixers.

★ This is the 144th of a series of ads featuring leaders in the Concrete Products Industry who are stepping up block production with Besser Vibrapac machines.

Another LEADER in the Block Industry!

"Under Sustained Daily Production, the Vibrapac is the Cadillac of the Concrete Block Industry"



• These words of commendation were spoken by Bruce C. Iliff, after more than 12 years experience with Besser Vibrapac machines. Mr. Iliff is President of the B & G Concrete Manufacturing Company, Long Beach, California.

B & G installed their first Besser Vibrapac in July, 1954. This machine has been under constant, day-in, day-out production with a minimum of maintenance required. The successful operation of their first Vibrapac prompted the company to order two more Vibrapacs, including one for their new plant at Imperial, California. In addition, they operate three Besser Mixers and a Besser Skip Loader.

With the finest and most dependable equipment, B & G has rapidly forged ahead in the block industry. They produce mostly "California" style block and split block under the trade name "Laguna Stone". Units are distributed through 115 dealers.

Why not join the Besser parade of successful blockmakers? Write today for literature.

BESSER Company

Dept. 139, Alpena, Mich., U. S. A.

First in Concrete Block Machines

• Interior view of Paramount Methodist Church, Paramount, Calif. Note exposed Vibrapac Block. All units supplied by B&G.

AB-164

(Above) Overall height, 21'6"; overall depth, 15'6"; overall width, 8'0"—including all-welded steadying structural framework and platform which supports 350-Gal. oil reservoir, pumping equipment and valves. Upper and lower crossheads slide in 90° V-type scraped cast iron adjustable ways.

Now . . . New!

CHAMBERS

High Speed, General Duty

30 or 50 TON PRESS

to meet all Your Requirements — whether for a

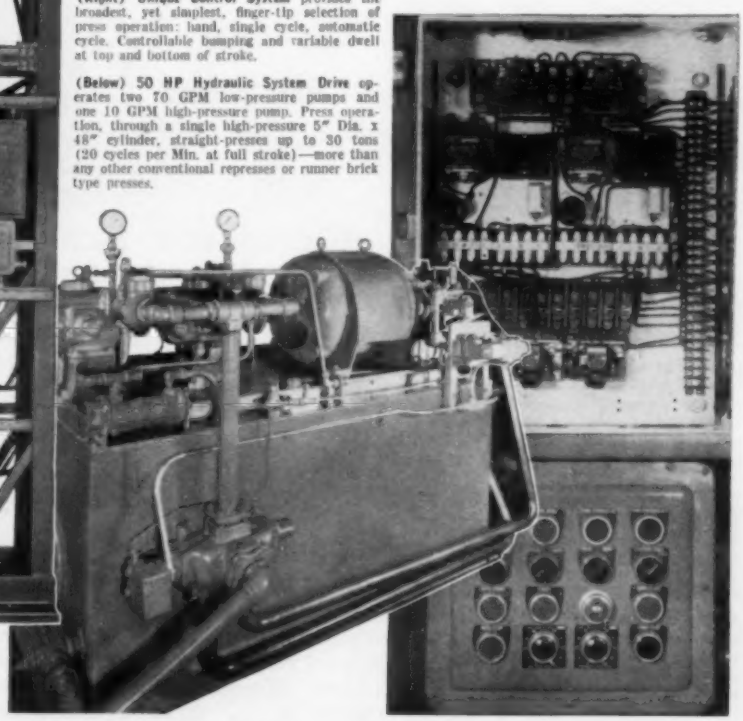
LARGE or SMALL REFRACTORY PLANT

Chambers scores with another new development: a high-speed press to fill the requirements of both large and small refractory plants. Thoroughly tried and tested, the General Duty 30- or 50-Ton Press rapidly and economically makes:

1. Sleeves and nozzles to 18" long burned,
2. Runner brick and bottom block,
3. Checkers and pierced shapes to 12" thick burned, and
4. As production repress with automatic feeder and off-bearing belt, double brick 13½" x 6", single block up to 15" x 18" burned (larger block on special order).

(Right) Unique Control System provides the broadest, yet simplest, finger-tip selection of press operation: hand, single cycle, automatic cycle. Controllable bumping and variable dwell at top and bottom of stroke.

(Below) 50 HP Hydraulic System Drive operates two 70 GPM low-pressure pumps and one 10 GPM high-pressure pump. Press operation, through a single high-pressure 5" Dia. x 48" cylinder, straight-presses up to 30 tons (20 cycles per Min. at full stroke)—more than any other conventional represses or runner brick type presses.



SERVING YOUR INDUSTRY FOR OVER 100 YEARS

CHAMBERS BROTHERS CO. 1857 1958

52nd & Media Streets · PHILADELPHIA 31, PA.

FIVE days' time completed the SWISS-LOK structural frame for this 54,300 sq. ft. building for Logan Clay Products Co. at Logan, Ohio.

ONE crane was the sole erection equipment required for this building structure for Davis Firebrick Company at Jackson, Ohio. Crane service was required but one-third the time of conventional erection because of fast SWISS-LOK connections.

Corrugated aluminized steel sheeting was selected by Davis Firebrick Company for this building at Oak Hill, Ohio. Any type of sheeting desired is applicable to SWISS-LOK structures.

Brick and Clay Products Companies get lower cost, faster building construction with SWISS-LOK Tubular Building Frames

LOWER COST BECAUSE:

Tubular members save ⅓ steel weight without loss of structural strength
⅓ less shipping weight
Greatly reduced crane service (no other equipment needed)
Greatly reduced erection labor hours

FASTER BECAUSE:

No welding, cutting, bolting or riveting at the site
All parts pre-fitted for quick assembly and locking
All frame members can be shipped by fast motor freight

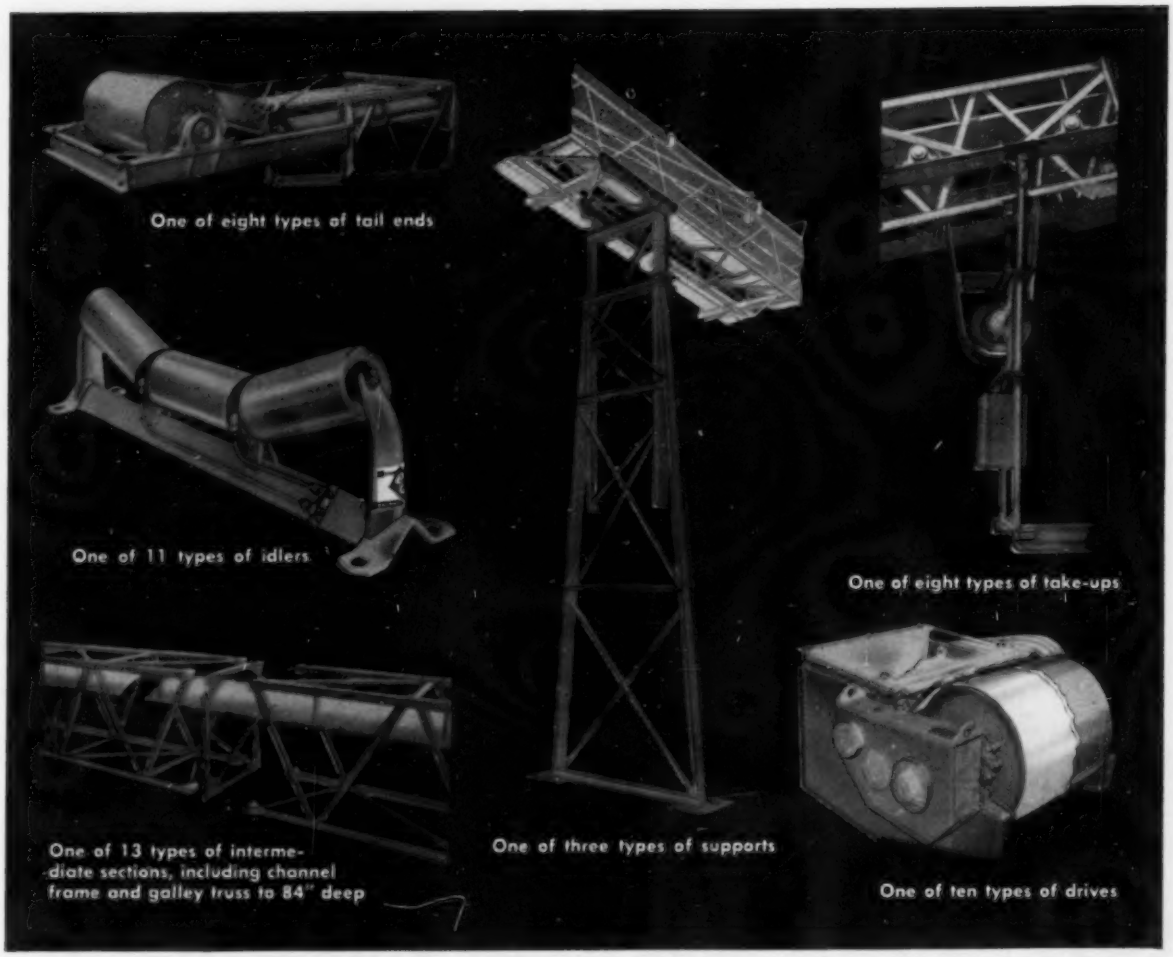
BETTER BECAUSE:

Swiss-Lok building frames do not depend on roofing and siding construction for support, alignment or rigidity
Truss chords are parallel to roof pitch, allowing more overhead space for movement or storage of materials
All new, tested pipe is used exclusively

All stress calculations for SWISS-LOK building structures conform with A.I.S.C. standards. Any type of roofing and siding may be used, and standard wall tying and sheet metal fastening are applicable. For descriptive, illustrated literature, write:

SWISS FABRICATING, INC.

Camp Horne Road, Pittsburgh 2, Pa. • Phone WEllington 1-2646


One of eight types of tail ends
One of 11 types of idlers
One of 13 types of intermediate sections, including channel frame and galley truss to 84" deep
One of three types of supports
One of eight types of take-ups
One of ten types of drives

Pictured here are just a few of the many Barber-Greene standardized conveyor components. Each is available in a wide variety of types and sizes, with unmatched flexibility for countless ways of assembly. Write for new bulletin.

Boost conveyor efficiency and cut costs with Barber-Greene standardized components

Every year, more and more belt conveyor installations — long and short, simple and complex — are made up of Barber-Greene standardized, "packaged" components. This standardization means fast, off-the-shelf delivery . . . almost limitless combinations of assembly that cut time and costs on any bulk material handling job . . . components completely interchangeable . . . spare parts readily available . . . simple selection and pricing right from the catalog. Light or heavy, Barber-Greene has the complete conveyor installation you need.

You save these six ways:

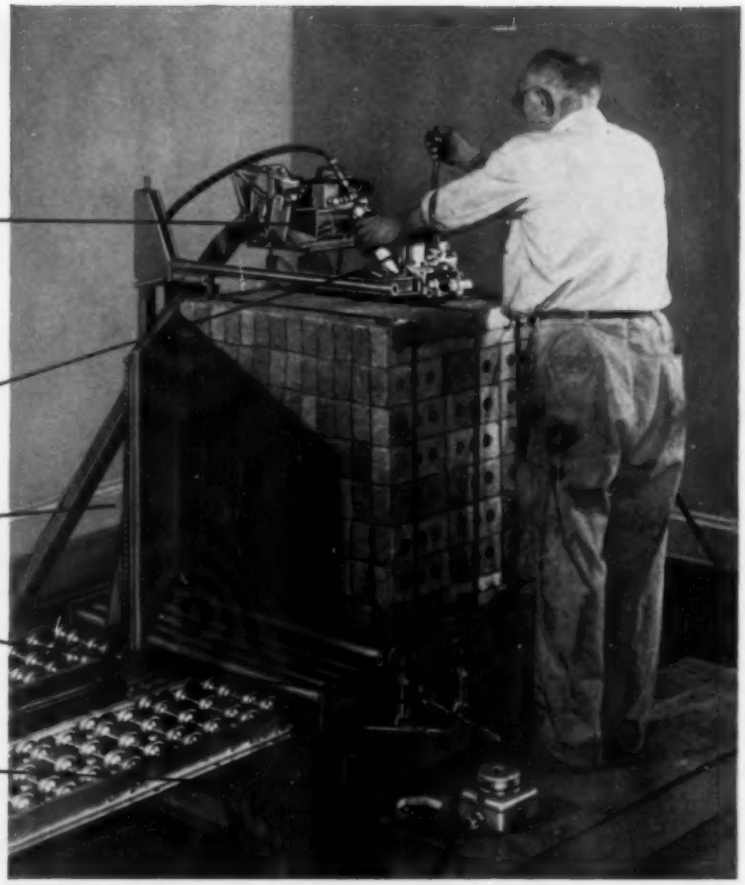
- You save special engineering time and expense.
- You save delivery time.
- You save erection time and expense.
- You save on alignment.
- You save on replacement costs.
- You save down time.

58-34-PE

Barber-Greene BG

AURORA, ILLINOIS, U.S.A.

CONVEYORS . . . LOADERS . . . DITCHERS . . . ASPHALT PAVING EQUIPMENT


New Signode PSF-1 Power Strap Feeder, powered by ¼-hp 115-volt AC motor, puts strap around pack in seconds.
Signode Model AP58 air-powered Seal Feed Strapping Machine. New Electric Model AE58 also available.
Gate, closed during stacking provides smooth-sided cube.
Foot controls position cube for second and third straps.
Foot pedal (lifted out of recessed position in platform for visibility) controls strap feeder motor.

NEW! Signode Semi-Automatic One-man Brick Strapping Station

How it works

The operator feeds an end of the strap into the Power Strap Feeder and presses the foot button. The strap is quickly fed, by ¼-horsepower electric motor, down behind the package, across beneath, and up to the operator at the front of the package. No helper needed. Air power in the strapping tool pulls the strap to the right tension every time. One stroke of the handle puts on the seal and cuts off the strap. The whole operation is completed in 8 to 10 seconds... is simply repeated as the package is moved to the next stop. Foot-operated stops provide positive positioning, so all straps go on straight at the right place.

• You'll strap brick at less cost in minimum time with this new setup. It is simple, dependable, foolproof, and adaptable.

The new Signode PSF-1 Power Strap Feeder and the famous Signode AP air-powered seal feed strapping machine are combined with a roller conveyor section to make this strapping station. Other combinations can readily be worked out by a Signode representative to meet your needs.

You'll want to see this station at work. Call the Signode man near you or write:

SIGNODE

First in steel strapping

SIGNODE STEEL STRAPPING CO.

2629 N. Western Avenue, Chicago 47, Illinois

Offices Coast to Coast. Foreign Subsidiaries and Distributors World-Wide
In Canada: Canadian Steel Strapping Co., Ltd., Montreal • Toronto

IF **YOU** MAKE and SELL BRICKS, YOU'LL BE CONSIDERING the **NEW CLAY BLOCK...** ...A STRONG CONTENDER TO RECAPTURE THE BACKUP MARKET

Design & Planning Facilities are at Your Disposal

The New Clay Blocks are being widely welcomed by brick manufacturers. Many believe they may prove to be the biggest development in the Clay Products Industry in years.

It is generally conceded that the highly valued "back up market" has been lost to the concrete products industry for many years.

A TYPICAL LANLY LAY-DOWN DRYER

Now comes a "light on the horizon" with the inception of the fired clay block. Here is a versatile product which unlike concrete does not absorb moisture. Cracking is virtually eliminated. Quality control during its manufacture assures uniformity of size and shape and the attractive color feature as in bricks makes it highly competitive with concrete blocks.

Why not investigate fully and contact us relative to your heat processing needs. We'll work closely with your organization to your satisfaction as we have with so many other manufacturers.

A TYPICAL LANLY MONORAIL DRYER

Central and South American Representative: Interkiln De Mexico S. A. Mexico 4, D. F.

LANLY Bulletin No. 572 is available for the asking. It contains a list of some of the prominent manufacturers LANLY has been privileged to serve.

Find Your Representative In The Yellow Pages

THE lanly CO.

CERAMIC OVENS & DRYERS

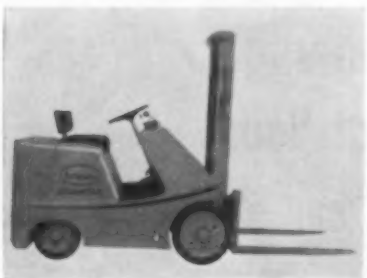
2800 Euclid Avenue • Cleveland 15, Ohio

Atlanta, Georgia • Birmingham, Ala. • Boston, Mass. • Chicago, Ill. • Cleveland, Ohio
Columbia, So. Carolina • Columbus, Ohio • Detroit, Mich. • Houston, Texas
Pittsburgh, Pa. • Rochester, N. Y. • San Francisco, Calif. • St. Louis, Mo.

NEW EQUIPMENT

Electric Drive Trucks

Automatic has developed a line of Dynamotive gas-powered electric-driven fork lift trucks, said to give high operating efficiency, low operation cost, and maximum safety. Briefly, gas engine powers a generator to an electric drive motor. This type of drive is reported to enable the gas engine to operate at its most efficient speed at all times. Capacities range from 4,000 lbs. to 10,000. Machine has no clutch, fluid coupling, fluid torque converter or multiple speed transmission; no mechanical direct coupling between engine and drive axle avoids transmission of road shock, lowers maintenance costs.



Automatic Transportation Co., Chicago 20, Ill.

672/Circle on Reader's Service Coupon

Sanford-Day Gismo Transloader

Sanford-Day is now producing a self-loading transport known as the Gismo, powered by crawler tractor. The unit consists basically of a large dipper with teeth, intermediate fold-back mechanism with adjoining and self-contained haulage body, and dump door. The dipper and fold-back action cascades material back into the Gismo until the large dipper loads itself and the entire machine then becomes a transport with about 6-ton payload.

The self-loading, self-dumping truck can be operated by one man. Can load, transport, dump in one continuous performance cycle.

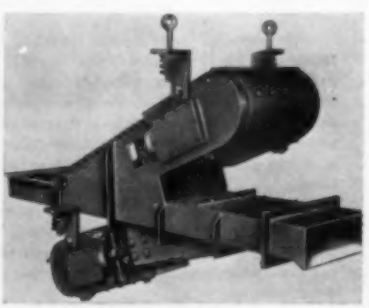
Sanford-Day Iron Works, Knoxville, Tenn.

Tornado Mill

F. J. Stokes has acquired the new "Tornado" mill, a granulating and mixing machine featuring 360° of screening area. The machine can be used in ceramic plants for reducing material to particle size or mixing and blending. The mill is available in three sizes. Material is ground and mixed by whirling blades which create an air flow that throws material outward at high velocity against a cylindrical mesh screen surrounding the rotor.

F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20.

673/Circle on Reader's Service Coupon



Hi-Capacity Feeders

Syntron's new special model heavy-duty electromagnetic vibratory feeders have been specially designed for high capacity feeding where installation space is limited. The feeders combine two standard electromagnet drive units to provide ample power for conveying heavy materials at fast rates through a long trough. Capacities range from 25 tph to 1000 tph in dry materials weighing about 100 lbs. per cu. ft.

Syntron Co., Homer City, Pa.

674/Circle on Reader's Service Coupon

Buying

Materials Equipment Services?

B&CR offers readers quick service for your inquiries concerning any of the keyed items in the New Products pages, on this card, or in the special information sections. You can also get additional, complete information on any advertisement in this issue.

All you do is circle the number of the editorial item or the page number of the advertisement on this card, and mail it to us.

NEW PRESS—Chambers has introduced a new high speed, general duty 30-ton press to use in large or small refractory operations. Unit makes sleezes and nozzles to 18" burned, runner brick and bottom block, checkers and pierced shapes to 12" thick burned and can operate as production repress. Chambers Bros. Co., Philadelphia, Pa.
619/Circle on Reader's Service Coupon

FLEXIBLE COUPLING—Para-Flex flexible couplings automatically compensate for end float, parallel misalignment, angular misalignment or any combination of these; cushions stress of shock loads, absorbs torsional vibrations. No lubrication needed, easily installed. Come in sizes up to handling 825 hp at 1200 rpm. Dodge Mfg. Co., Mishawaka, Ind.
620/Circle on Reader's Service Coupon

HAMMERMILLS — Miller hammermills have high speed impact to get particle-to-particle impact for greater crushing efficiency, giving also a high percentage of fines. Come in 50 and 100-ton capacities. Miller Equipment Co., Salisbury, N. C.
621/Circle on Reader's Service Coupon

BELT CONVEYORS—Barber-Greene now has a low cost belt conveyor available in lengths to 102', coming in 1' increments. Because transfer-conveyor is pre-engineered of standard parts, cost is cut in installation, shipment is right from stock. Sectionalized construction allows easy alterations to meet future needs. Barber-Greene Co., Aurora, Ill.
627/Circle on Reader's Service Coupon

FEEDERS, WEIGHERS — Omega has a full line of continuous feeders and weighers, including the belt stream weigher for continuous weighing of dry materials; the belt gravimetric feeders; volumetric disc feeder, batch counters and accessories. Also two sizes, four capacities of dust collectors. Omega Machine Co., Providence, R. I.
623/Circle on Reader's Service Coupon

ALUMINUM BUILDINGS—Kaiser makes roofing and siding installations for brick and clay product plants that give long life at low initial cost, using corrosion resistant material. Construction jobs can be done quickly to avoid plant down-time loss as much as possible. Kaiser Aluminum & Chemical Co., Oakland, Calif.
624/Circle on Reader's Service Coupon

BLOCK-O-MATION—Besser has 4 simple ways to handle brick or block by power, actually being automation for block plants. Four units include bridge crane block cuber, power Cubeveyor, Turn-A-Rack and Brickveyor. Besser Co., Alpena, Mich.
625/Circle on Reader's Service Coupon

PIPE PRESSING—Steele equipment can get adequate pugging, tempering of clay plus machine's adaptability to allow for feed under vacuum right into chamber of pipe press, eliminating need for wet pans. Units can be mounted in line, at right angles, to fit your needs. J. C. Steele & Sons, Statesville, N. C.
626/Circle on Reader's Service Coupon

BELTING—Ton-Tex Oil-Ex belt is reported to be tough, durable belt, highly resistant to oils, water, heat, abrasion, well suited to use under brick cutting machinery. Belt has minimum shrinkage and stretch; comes in 2 types of duck, 7 weights. Ton-Tex Corp., Grand Rapids, Mich.
622/Circle on Reader's Service Coupon

SCREEN PLATES — Mallix finger bars and grate bars are said to give economical costs per ton of lightweight aggregate. Finger bars give uniform air distribution and have excellent self-cleaning properties; can be furnished for any desired slot openings. National Malleable & Steel Castings
628/Circle on Reader's Service Coupon

Please send me more information concerning the items I have Circled.

11-58

619-Chambers Bros.
620-Dodge Mfg. Co.
621-Miller Equipment
622-Barber-Greene
623-Omega Machine
624-Kaiser Aluminum
625-Besser Co.
626-J. C. Steele
627-Ton-Tex
628-National Malleable
629-Ohio Kilns
630-Ferro Corp.
631-Gravely Tractors
632-Dwight B. Hendryx
633-Pacific Coast Borax
634-Crescent Belt Fastener
635-Scandinavia Belting
636-Rockfacer Co.
637-North State Pyrophyllite
638-Towmotor Corp.
639-Harbison-Walker
640-North American Mfg.
641-Williams Pat. Crusher
642-Syntron Co.
643-Titanium Alloy
644-Bonnot Co.
645-Bristol Co.
646-Metal & Thermit
647-Timken Bearing
648-Sanford-Day
649-Harrop Ceramic Service
650-Signode Steel
651-Lanly Co.
652-Toronto Foundry
653-Universal Atlas
654-T. L. Smith
655-Westinghouse Electric
656-Ortruc Inc.
657-Orefraction
658-Van Gorp
659-Bradney Machine
660-Universal Screen
661-Gem Clay Forming
662-Tack-L-Hoist
663-Robeson Process
664-Robinson Ventilating
665-International Clay Machry.
666-Clearfield Machine
667-Hauck Mfg.
668-R. G. Varner
669-Nat'l. Paint-Manq.
670-Chase Foundry
671-Ed. Orton Foundation
672-Automatic Transportation
673-F. J. Stokes
674-Syntron Co.
675-Sanford-Day Iron
676-J. I. Case
677-Miller Fluid Power
678-Besser Co.
679-Baldwin-Lima-Hamilton
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Page 65 Pacific Coast Borax
Page 67 Cabot, Godfrey L.
Page 68 Berkshire Chemicals
Page 68 Rockfacer Co.
Page 71 Omega Machine
Page 72 Chisholm, Boyd & White
Page 75 Syntron Co.
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Page 76 Clearfield Machine
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Page 83 Gravely Tractors
Page 83 Robinson Ventilating
Page 85 Deister Concentrator
Page 86 Steele (J. C.)
Page 87 Fate-Root-Heath
Page 88 American Clay Machry.

NAME..... TITLE.....

COMPANY.....

STREET.....

CITY..... ZONE..... STATE.....

This card void after January 28, 1959

KILNS — Clipper kilns are producing brick, drain tile and other products in many installations, producing 10,000 to 24,000 brick equivalents per day. Kilns are sold on firm price, so buyer knows what cost will be for complete job, erected and operating. Ohio Kilns, Granville, Ohio.
629/Circle on Reader's Service Coupon

COLOR BRICK—Ferro provides service to help you work out best techniques, processes and quality controls for glazing, engobe, body stains, or sandblasting in brick coloring. Ferro's inorganic colors have uniformity and stability. Ferro Corp., Cleveland, Ohio.
630/Circle on Reader's Service Coupon

CAR MOVER—Gravely LS tractors are used in many brick plants to move kiln cars in and out of kilns and to other stations. The tractor is a geared-down 5 hp low speed model with dual wheels and governor. Small enough to work in crowded areas, moves cars of up to 310,000 lbs. Has other uses around plant. Gravely Tractors, Inc., Dunbar, W. Va.
631/Circle on Reader's Service Coupon

TUNNEL KILNS — Complete plant design (such as at Logan Clay), tunnel kilns, dryers of continuous or room type, and plant consulting service—all can be had from Dwight B. Hendryx & Assoc., Pittsburgh, Pa.
632/Circle on Reader's Service Coupon

GLAZES—Rasorite, said to be cheaper than either borax or boric acid, gives fine results in making glazes more durable, more impervious to liquids, freer of crazing in pipe manufacture. A borate-salt mixture is reported to lower fuel costs, increase production and profits. Pacific Coast Borax Co., Los Angeles.
633/Circle on Reader's Service Coupon

BELT FASTENERS — A hammer is all that is needed for installation of Crescent plates for joining and repairing conveyor belts. Can handle any width of joining, any thickness of belt, and any length of repair. All sizes of pulleys. Crescent Belt Fastener Co., New York, N. Y.
634/Circle on Reader's Service Coupon

CONVEYOR BELTING — Scandura belting can withstand abrasion, said to be exceptionally tenacious in holding fasteners, solid-woven base with covers that will not strip or tear; not affected by water, dilute acids, etc. Scandinavia Belting Co., Newark, N. J.
635/Circle on Reader's Service Coupon

ROCKFACING—The Rockfacer can convert culls into premium brick, at the rate of 2000 per hour. Simple operation by two-man crew, with low-maintenance costs on machine. You can send samples of your brick for Rockfacing. Rockfacer Co., Mesquite, Tex.
636/Circle on Reader's Service Coupon

CAR TOPS—By Paco are said to cut replacement cost as much as 50% by North State. Reasons include the tops' resistance to spalling, with first quality material meaning a good hot load test. North State Pyrophyllite Co., Greensboro, N. C.
637/Circle on Reader's Service Coupon

FORK TRUCKS—A compact Towmotor fork lift truck can handle heavy loads, enter carriers, box cars, kiln doors easily. Mechanical handling of brick and other clay products speeds production, lowers manpower costs. Towmotor Corp., Cleveland, Ohio.
638/Circle on Reader's Service Coupon

H-W CAR TOPS—Harbison-Walker has a line of car top refractories that have good strength over the entire range of working temperatures, high resistance to thermal shock. Line includes H-W 56 lightweight castable and H-W 85 lightweight castables, spanner tile, others. Harbison-Walker Refractories Co., Pittsburgh.
639/Circle on Reader's Service Coupon

SHUTOFF VALVES — North American produces safety shutoff valves to prevent chances of gas furnace explosions due to left open gas cocks after shutdown. Shutoff valves, in nine sizes, prevent possibility of this happening, have provisions for protection against dirt, corrosive gases, weather. North American Mfg. Co., Cleveland, Ohio.
640/Circle on Reader's Service Coupon

CRUSHING—Williams heavy duty hammer mills can finish grind bank run clay and shale in a single operation, saving up to 75% of capital investment by eliminating primary or secondary crushers, conveyors, etc. Extra-heavy construction. Williams Pat. Crusher & Pulverizer Co., St. Louis, Mo.
641/Circle on Reader's Service Coupon

FEEDERS—Syntron Gravimetric feeders allow accurate, continuous feeding by weight. Fully automatic, feed rate is electronically controlled by the load on a scale suspended, constant speed conveyor belt. Syntron Co., Homer City, Pa.
642/Circle on Reader's Service Coupon

OPACIFIER—By adding an extra percentage of TAM, quality can be improved, rejects cut according to findings of Titanium Alloy. Addition can help cut respraying and refiring substantially. Titanium Alloy Mfg. Co., Div. National Lead Co., New York City.
643/Circle on Reader's Service Coupon

CLAY WORKING—Machinery by Bonnot is reported to give highest quality products, greatest cost control and simplified maintenance because of Bonnot's experienced engineering, 75-year experience, advanced research. Complete line of equipment including auger machines, ball mills, brick cutters, crushers, pug mills, rotary dryers, many others. Bonnot Co., Canton, Ohio.
644/Circle on Reader's Service Coupon

FIRST CLASS
Permit No. 183
Chicago, Ill.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY

BRICK & CLAY RECORD

5 South Wabash Avenue

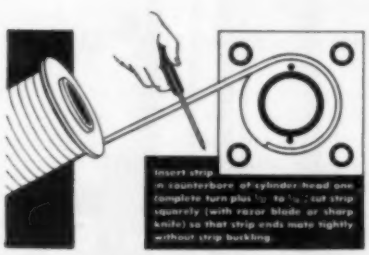
Chicago 3, Illinois

Loader-Dozer

A 2-in-1 combination ⅝-yd. loader and dozer is being made by Case, known as the Utility 310, reported to cost only slightly more than a single-purpose machine. Vertical connecting arms between loader and dozer serve as lift when operating the full-size blade. Switching to loader position is said to take only five minutes to pull 4 pins in connecting arms; no change in the hydraulic system at all.

J. I. Case Co., Racine, Wis.

676/Circle on Reader's Service Coupon


Insert strip
in counterbore of cylinder head one
(complete turn plus ½" to ¾"; cut strip
squarely (with razor blade or sharp
knife) so that strip ends mate tightly
without strip buckling.

Seal Replacement

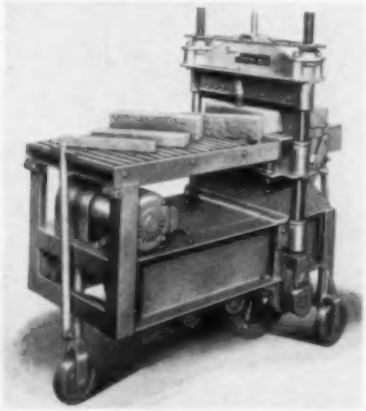
A new method of replacing certain types of power cylinder seals is reported to save maintenance time, to eliminate the need of stocking a wide variety of sizes of seals for different bore hydraulic cylinders. Seals replaced by the new method are Miller piston rod bushing seals and the SHEF tubing end seals. By making both seals available in strip form on spools, Miller estimates that up to 23 seal sizes no longer need to be in stock, being replaced by the two spools. Proper length sections of seal can be cut off the spool.

Miller Fluid Power Div., Melrose Park, Ill.

677/Circle on Reader's Service Coupon

Block Splitters

Besser has announced a new, complete line of block splitters known as the Contour-Matic. Models range from largest 16" and 24" powered splitters



down to three on-the-job splitters. All splitters except the smallest feature the patented self-leveling Contour-Matic upper and lower blade arrangement which is said to eliminate cross-breakage and reduce culls.

Besser Co., Alpena, Mich.

678/Circle on Reader's Service Coupon

Power Shovels

Two new additions have been made to the Lima line of power shovels, cranes, draglines, etc. These are the type 64 and 64-SC models with the 64 rated at 40 tons when equipped

as a crane. When equipped as a shovel, it has 22' boom, 17' dipper handle and 1¼ cu. yd. dipper. Both 64 and 64-SC have identical truck bases, with two widths of axles and two lengths of crawler side frames available. Standard crawler is 13'3" long, 10'8" wide with 30" treads.

Baldwin - Lima - Hamilton Corp., Lima, Ohio.

679/Circle on Reader's Service Coupon

Belt Repairs

A belt repair kit featuring Crescent fastener plates in 20 assorted sizes, and 144 assorted rivets for attaching the plates, has been announced. The plates and rivets are especially designed for the repair of tears, holes and rips in belts of all sizes and thicknesses. Fasteners punch no holes in belt, rivets are self-clinching. All that is needed for use is a hammer.

Crescent Belt Fastener Co., New York City 16.

680/Circle on Reader's Service Coupon

Outdoor Fork Trucks

Two new "Ranger" fork trucks of 4000 and 6000 lbs. capacity, designed for high speed handling and rough terrain, have been introduced by Clark. Units can be equipped with two wheel or four wheel drive; have high lift speeds.

Clark Equipment Co., Battle Creek, Mich.

681/Circle on Reader's Service Coupon

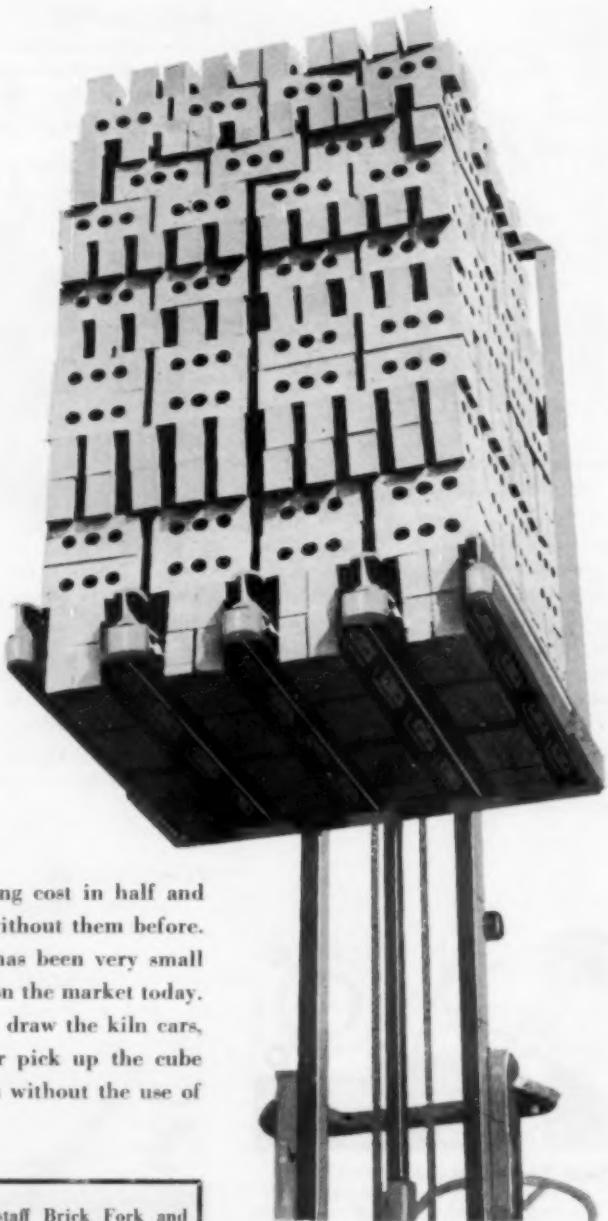
Moving?

If you're planning to move, remember to arrange for BRICK & CLAY RECORD to follow you. We need at least six weeks notice in advance of your moving date if you want to be sure to avoid missing an issue. Send your change of address to BRICK & CLAY RECORD, 5 South Wabash Ave., Chicago 3, Ill. Be sure to give both old and new address, zone number, and your name.

BROAD RIVER BRICK CO. says . . .

Bickerstaff Brick Forks

"cut handling costs in half"



"The use of your forks has cut our handling cost in half and now it's hard to realize how we got along without them before. The maintenance on the Bickerstaff Fork has been very small and we feel that it is the most efficient fork on the market today. One of the nice features is that now we can draw the kiln cars, move the cubes to a storage area and later pick up the cube again for loading onto trucks or in box cars without the use of pallets or additional labor."

In 1954, Broad River Brick Company purchased a Bickerstaff Brick Fork and started drawing all brick from their kiln cars mechanically to reduce handling cost. They have since purchased other Bickerstaff Forks and now fork-handle their brick 100%.

ONE FORK DOES THE JOB OF THREE

One Bickerstaff Fork, this standard 4 x 3 model, handles Standard, SCR, and Norman brick. Other models to handle every masonry unit.

Inquire today about a Bickerstaff Brick Fork to cut your operating costs and increase output.

Bickerstaff, Inc.

COLUMBUS, GEORGIA

Manufacturers, Engineers, Designers of Materials Handling Equipment

Dealers throughout U. S. and Canada

West Coast Representatives: WALTER C. STOLL & SONS, 5028 Alhambra Avenue, Los Angeles 32, California

FINGER-TIP CONTROL Narco and Harrop collaborated to develop this well-organized layout of control panel for new Harrop kiln at North American Refractories Co. plant, Curwensville, Pa. With 2-zone automatic, full-proportioning control chart-recorded, operator also takes hourly readings of other temperatures throughout the kiln. Multi-point electronic indicator brings all thermocouple leads to one convenient, easily accessible location. Air motor operates automatically controlled damper in exhaust. Together with air-lock, this maintains constant draft conditions throughout kiln.

NARCO's new HARROP KILN fires up to 40,800 9" equivalents daily with stubborn Penna. clays

Pennsylvania clays are tough to fire. High carbon and sulphur content make oxidization difficult. Yet Narco's two Harrop kilns at Curwensville produce a high-quality line of refractories from these stubborn clays. Production includes dry press, stiff mud repress and hand-made shapes.

Narco's first Harrop installation, completed in 1953, consisted of a 172′ dryer and a 393′ kiln. To keep up with sales demand that far exceeded initial expectations and outgrew capacity, Narco again turned to Harrop for their present, enlarged facilities. Harrop doubled the size of the existing dryer to 344′. This gives plenty of dryer capacity to serve the original kiln **plus** an additional Harrop kiln, 476′ long, which fires up to Orton cone 18. This new kiln produces up to 40,800 9″ equivalents in 24 hours, despite the hard-to-oxidize clays. At this production level, design capacity is exceeded by 36%.

For the dryer, kiln or plant design to give you efficient, profitable production, consult Harrop. Our 37 years of proven engineering and construction experience is available to help you plan your new installation, without obligation.

HARROP DRYER gives easy control of temperature and humidity during the various stages of the cycle, to dry special shapes such as the rotary kiln shapes shown being discharged from the dryer.

ON THE WAY-Mixed setting of brick and shapes enters charging end of new Harrop kiln. Note hydraulic pumping unit for pusher at right. Natural gas is now being used with oil standby, for firing up to Orton cone 18.

READY FOR STOCK-Refractory brick and shapes leave open-end kiln in continuous motion. Because of efficient, profitable performance of both Harrop installations at Curwensville plant, Narco has new Harrop-designed facilities in operation in its new Farber, Mo. plant.

HARROP

TUNNEL KILNS • DRYERS • PLANT DESIGN

Harrop Ceramic Service Co.

35 EAST GAY STREET, COLUMBUS 15, OHIO

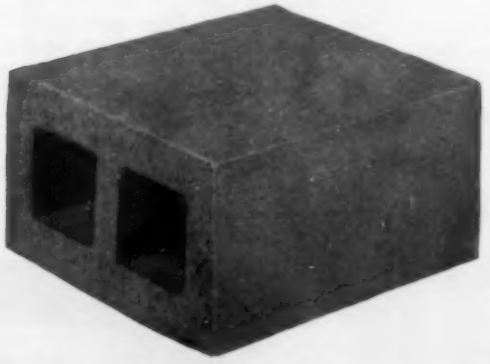
British Associate: British Ceramic Service Co., Ltd. Bricesco House, Stoke-on-Trent, England
Harrop Electric Furnace Division, 3470 E. Fifth Ave., Columbus 19, Ohio . . . Laboratory, Industrial and School Furnaces

HARROP . . .
Practical Ceramic Engineering, Put Profitably to Work

Photo shows PACO 4½" x 8" x 9" car tops set on end and used as perimeter block. Top deck is constructed with 4½" x 8½" x 18" PACO car tops. Each corner has a 7" x 8½" x 9" cored corner block. Perimeter and corner blocks are filled with lightweight insulation.

PACO CAR TOPS can cut your replacement costs as much as 50%—and increase your profits! The reason is simple. Paco Car Tops are made from the mineral pyrophyllite. This unusual, superior raw material permits the manufacture of thinner wall, larger core car top that is lightweight, stronger and highly resistant to extreme thermal shock.

PACO CAR TOPS do not have a softening point below actual fusing point, providing greater resistance to hot load deformation. The result is better, more efficient production. Paco Car Tops are easy to handle and install, and simple to replace individually as needed.
There is a PACO engineer as close as your telephone—or write for complete information!

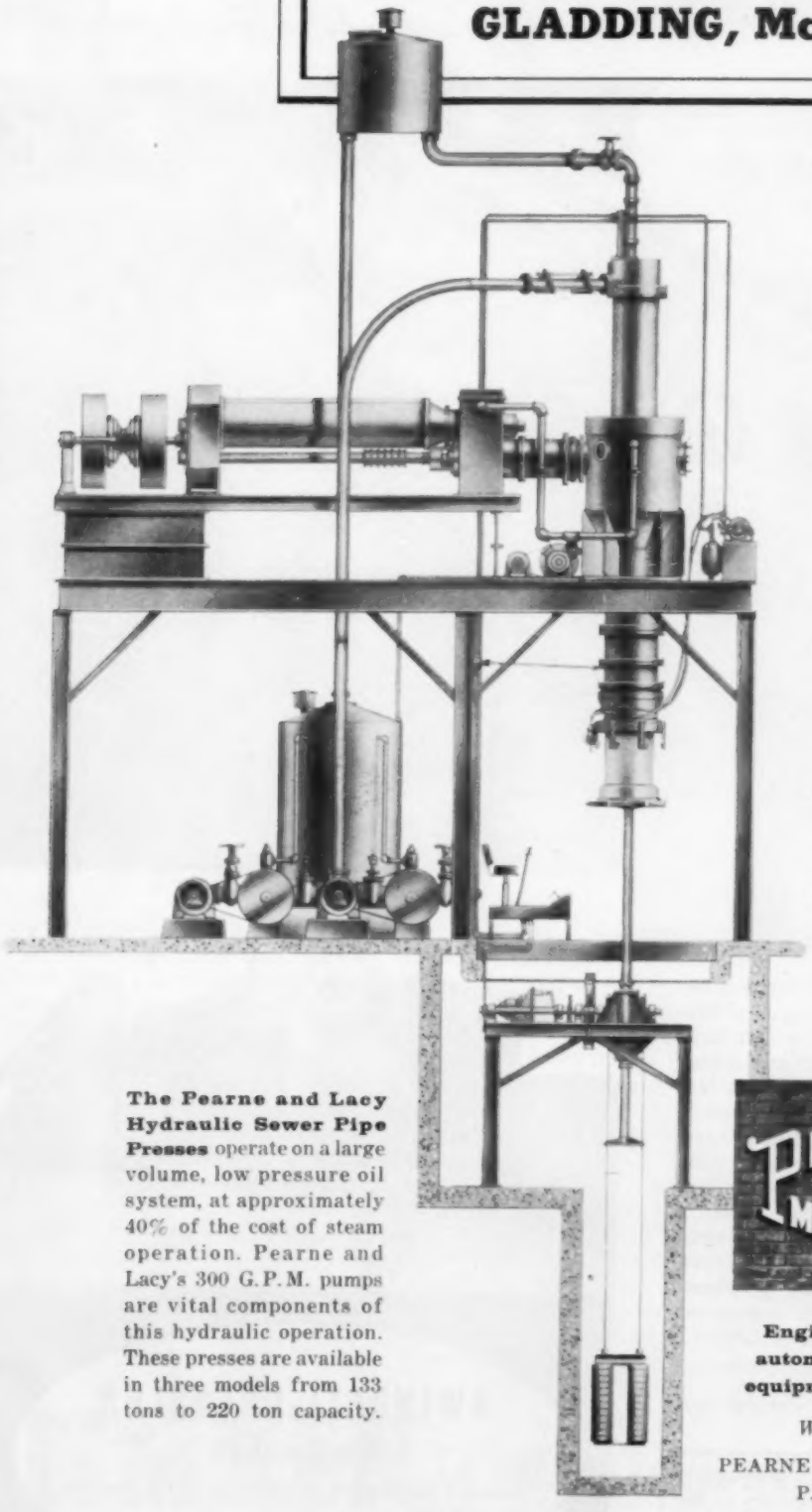


NORTH STATE PYROPHYLLITE COMPANY, INC.

Telephone BRoadway 4-7055 Greensboro, North Carolina

OTHER PACO PRODUCTS INCLUDE: • Paco Plastic • Pacocast • Paco H.T. Cements • Paco Fire Brick Mortar • Paco Side Car Brick • Paco Fire Brick • Paco Ladle Lining • Paco Heatzone Compound

PEARNE AND LACY *Proudly Salutes* GLADDING, McBEAN & CO.



We appreciate the opportunity this great organization accorded us in supplying the following major equipment now in operation at their Corona plant:

- Hydraulic Sewer Pipe Press with 28 inch cylinder and 220 ton capacity (Illustrated)
- Off-Bearing, Finishing and Palletizing Equipment for 4, 6, 8, 10 and 12 inch sewer pipe production
- Kiln Cars with Hyatt Bearings
- Hydraulically Operated Transfer Cars
- Kiln Car Pusher complete with over-head ram and hydraulic pumping unit
- Dryer Car Pushers

The Pearne and Lacy Hydraulic Sewer Pipe Presses operate on a large volume, low pressure oil system, at approximately 40% of the cost of steam operation. Pearne and Lacy's 300 G.P.M. pumps are vital components of this hydraulic operation. These presses are available in three models from 133 tons to 220 ton capacity.

PEARNE AND LACY INC. MACHINE COMPANY

Engineers and Manufacturers of automatic handling and finishing equipment for the Ceramic Industry

Write for copy of new catalog

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MEETING TOUGH OXIDATION AND CLOSE FIRING CONTROL REQUIREMENTS

for **STARK CERAMICS, Inc.**

in burning glazed structural products

This DRESSLER multi-burner recuperative KILN

Stark Ceramics' new Dressler Kiln is big in size, capacity and performance! With a length of 315 ft, car setting area is 7 ft 1 in wide by 9 ft long and 5 ft high (largest in the glazed structural tile industry); output is 80 tons of product per day. The kiln is of recuperative* multi-burner design, with special provision for oxidizing large amounts of carbon and pyrites in the clay, plus the controlled cooling required for glazed hollow ware. Proper maturing of body and glaze is maintained by four zones of automatic temperature control and automatic furnace pressure control. • When your particular firing problems or product requirements call for an *engineered* kiln, consult with SWINDELL-DRESSLER.

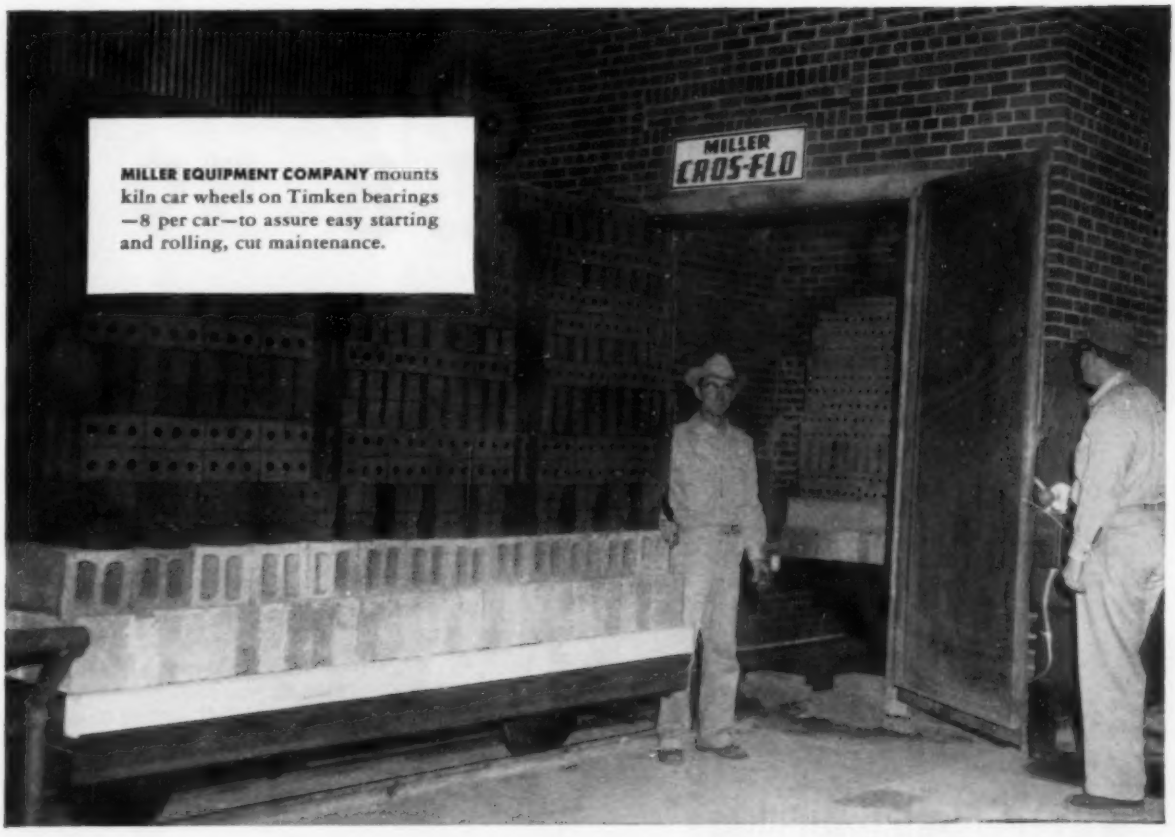
*70% of combustion air is pre-heated in the ware cooling zone; only 30% of the air is drawn from outside . . . a method of firing saving 12% to 20% or more of fuel costs, depending upon operating temperatures.

Swindell-Dressler Corporation provides a complete engineering service for the ceramic industry in the design and construction of new plants, and modernization of existing facilities. Consultations arranged gladly on request.

SWINDELL-DRESSLER Corporation

DESIGNERS AND BUILDERS OF MODERN INDUSTRIAL FURNACES

PITTSBURGH 30, PA.



MILLER EQUIPMENT COMPANY mounts kiln car wheels on Timken bearings —8 per car—to assure easy starting and rolling, cut maintenance.

One man can push kiln car on TIMKEN® bearings! Wheels need lubrication only once in three months!

TO make an easy one-man job instead of a tough two-man job of pushing loaded kiln cars, Miller Equipment Company mounts the car wheels on Timken® tapered roller bearings. With little extra effort, one man can push a fully loaded 30,000 lb. car, do it without pinch bars. And wheel lubrication is sharply cut, from once or more every cycle through the kiln to only once every three months.

Timken bearings practically eliminate friction. They are geometrically designed to roll true. And they're precision-made to live up to their design. They run smoother.

Timken bearings make closures more effective. Lubricant stays in. Dust and dirt stay out. Both lubricant and maintenance time are saved.

The tapered design of Timken bearings lets them take *both* radial and thrust loads in any combination. Full line contact between rollers and races gives Timken bearings extra load-carrying capacity. The rollers and races are case-carburized, giving them hard, wear-resistant surfaces and tough, shock-resistant cores. They take heavy loads, take them longer.

And for extra quality control, we even make our own electric furnace fine alloy steel. No other American bearing maker does. So for your No. 1 bearing value, specify bearings trade-marked "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.

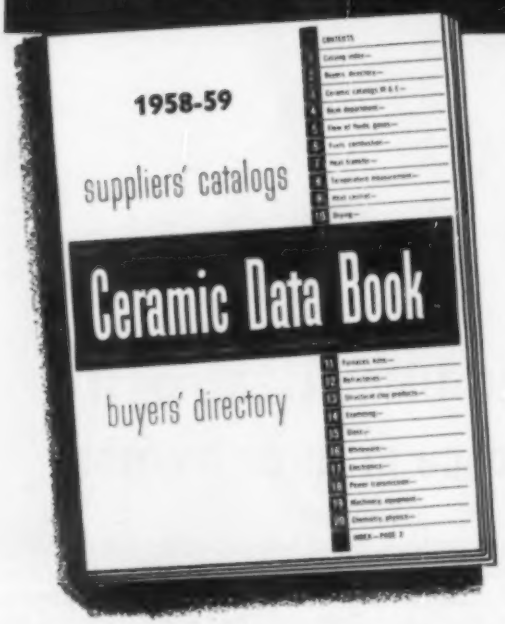
TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

TRADE-MARK REG. U. S. PAT. OFF.

YOUR COMPLETE SUPPLIERS' GUIDE

THE NEW 1958-59

Ceramic Data Book



New tabular graphic technical information for all ceramic industries and processes

Enlarged Buyers Guide and information index

New Catalogs of Equipment and Raw Materials Suppliers

Be sure to thumb through your copy immediately—to acquaint yourself with the new products and items—for future reference—it's important to your building and production planning.

Ceramic Data Book

5 South Wabash Avenue **Chicago 3, Illinois**

Portable Conveying Systems Trim Costs in Brick Plants

Profits Up—Costs Down

In today's modern plant, material handling expense frequently is an appreciable percentage of production costs—in some cases running as high as 25 to 30%. Therefore, even a 10% reduction in conveying costs will provide the equivalent of a substantial increase in sales.

Eliminates Manual Handling

Executives seeking methods to cut down on production and maintenance costs can find a relatively inexpensive solution to their handling problems in the new *award winning* Hoffco-Veyor portable conveying units. These units have trimmed costs as much as 80% and increased plant efficiency more than 20% in the brick, chemical and other manufacturing industries. Many pick up and disposal functions in manufacturing and maintenance operations formerly handled manually are now the responsibility of Hoffco-Veyors. From either a fixed location or at various points in the plant, the one-man operated Hoffco-Veyor keeps materials moving rapidly to provide substantial time, labor and product savings.

Industrial "Work Horses"

Hoffco-Veyors are extensively employed in brick, shipbuilding, foundry, petroleum, chemical and numerous other industries. Veritable "work horses" they handle a wide range of rugged duty jobs such as conveying brick chips, rock granules, gritty substances, sand, shot blast, plastic pellets, etc. In numerous manufacturing and production operations, Hoffco-Veyors meet the toughest service demands—pick up spilled materials, empty drums, clean pits and recover spent shot. For example, in a large chemical plant, a portable Hoffco-Veyor conveys catalyst pellets from reactor tanks. It is also used in trimming operations, collection of metallic chips and other tasks with these advantages:

- Rapid pneumatic loading and unloading of hoppers and containers.
- Higher production levels through reduced machine downtime.
- Easy maneuverability in crowded or virtually inaccessible areas.
- Can be hooked up to stationary piping for reaching remote areas.
- Streamlined design and compact construction assures years of dependable operation — minimum maintenance costs.
- Simple adaptor cover permits use of standard 55 gallon drums as auxiliary collectors.
- Facilitates changeovers in mixed runs, prevents mixing of materials.
- No dangerous moving parts.
- Low in first cost.
- Flexible enough for use as a vacuum cleaner — unit equipped with inlet valve to take standard size 1½ to 2 inch vacuum hose for ordinary cleaning operations when not in use as a conveyor.

Savings In Your Plant

If your plant is using a non-automatic method of conveying, you can achieve savings comparable to those cited in the free booklet describing how a portable Hoffco-Veyor saves 80% on labor costs and increases plant efficiency 20% at the Westfield Clay Products Co., Westfield, Massachusetts. Here, sand and broken pieces of brick formerly removed laboriously from underground flues by bucket and shovel are pneumatically conveyed by Hoffco-Veyors.

Free Booklets

To insure higher profits today and in the years to come, send for the free booklets describing how portable Hoffco-Veyors and stationary conveying systems can cut operating and maintenance costs in your plant. Mail coupon now.

Kindly send the following FREE booklets.

U.S. HOFFMAN MACHINERY CORPORATION

Dept. L3
Air Appliance Division
103 Fourth Avenue
New York 3, N. Y.

☐ HV 101. How a Portable Hoffco-Veyor saves 80% on labor costs and increases brick plant efficiency 20%.

☐ PB 500. How Stationary Pneumatic Conveying Systems cut costs, increase plant efficiency.

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COMPANY.....

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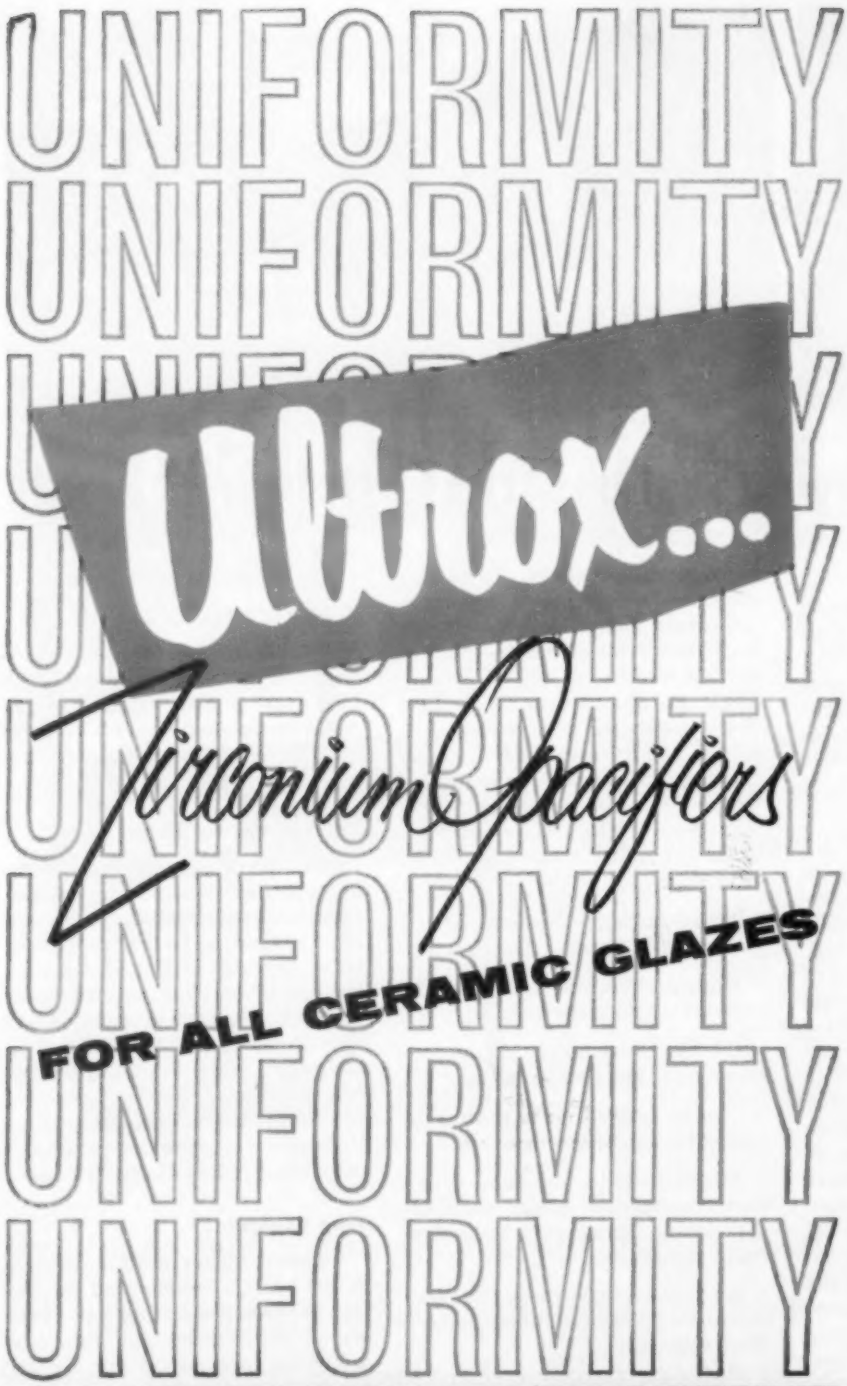
Please say "I saw it in B&CR"



■ From mine to kiln, batch to batch, the big word behind Ultrox Zirconium Opacifiers is uniformity. Assuring Ultrox uniformity are control tests far more demanding than actual conditions of use. Here's how M&T spells uniformity . . . . in every bag, every drum of Ultrox or Ultrox 500W:

- **Selected ores are continually analyzed both at the mine and at M&T processing plants to set the course for highest quality.**
- **Processing equipment is automated to safeguard against human error.**
- **Constant checking controls chemical analysis and assures uniform particle size.**
- **Fired glaze tests are made to appraise color and opacity —before any lot is approved for shipment.**

Write for useful literature or an assist in solving your brick or other ceramic glaze problem.

METAL & THERMIT
CORPORATION
GENERAL OFFICES: RAHWAY, N. J.
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GLAZE OPACIFIERS
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METAL & THERMIT 60TH YEAR

Brick & Clay Record

November, 1958 Vol. 133, No. 5

5 SOUTH WABASH AVE.
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FRanklin 2-6880

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now in 68th year.

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BRICK AND CLAY RECORD is indexed by Engineering Index, Inc.

HAROLD H. ROSENBERG, Founder
1882-1958

BM&PIU Helps Industry Move Ahead

On the opening news page of this issue is a vitally important announcement from the BM&PIU, an announcement that can be classed as a major breakthrough in industry advancement.

The BM&PIU has announced that their locals will be allowed to use "any instruments" to increase productivity and cut costs of masonry. This includes the SCR Masonry Process and various corner pole operations.

We at B&CR feel the industry should wholeheartedly thank Pres. Harry Bates and his BM&PIU men for proving their foresight and interest in the advancement of our industry. The amendment to their constitution was passed by democratic process, reflecting the interest of the whole union in finding better ways to increase the use of masonry in homes.

One of the great needs of our industry today is finding ways to keep the quality of masonry competitive in cost to substitute materials. By aiding the advance of cost-cutting methods, the BM&PIU has graphically shown their desire to join the effort to promote the use of masonry. By their action, the BM&PIU people have refuted all the stale claims of brick laying restrictions; instead, they've proved that they have the interests of masonry foremost.

With this measure approving "any instruments" to improve productivity, the BM&PIU has proved their right to be ranked among the most forward looking of the country's unions. The entire brick industry should so congratulate them.

The Editors

TAPER-LOCK STEEL CONVEYOR PULLEYS

Maximum strength with minimum weight...

Unmatched holding power on the shaft...

New mounting simplicity.

The rims, discs and hubs of these modern conveyor pulleys are *steel*—and they are fused together into jointless drum construction for (1) maximum strength with minimum weight, (2) exclusion of dirt, water, steam, (3) terrific shock resistance.

With the patented Dodge Back-up Bar, welds of full rim thickness are achieved—and the ultimate in strength is assured by submerged arc process welds.

Taper-Lock Steel Conveyor Pulleys *hold*. Taper-Lock provides the equivalent of a shrunk-on fit—there is no "walking" on the shaft. Mounting and demounting are simple. Pulley and bushings mount as a unit. Alignment is easy. And the tapered bushing is wedged into place merely by turning the mounting screws. It is "unlocked" by using the mounting screws as jack screws.

Available in diameters from 6 inches to 8 feet—all face widths. Standard or special rubber lagging available. Ask your local Dodge Distributor—or write us for bulletin.

DODGE MANUFACTURING CORPORATION, 4900 Union, Mishawaka, Ind.

97 Taper-Lock Steel Conveyor Pulleys are used in this famous conveyor system engineered, manufactured and erected by Hewitt-Robins, Inc., at the Southern Pacific's causeway construction across the Great Salt Lake.

DODGE

of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

NEWS OF THE INDUSTRY

New Builder's Plant About 50% Complete

Construction of buildings to house the new Builders Brick Co. plant in Seattle, Wash., is about 50% complete, according to R. C. Houlahan, president of the company.

As of the announcement in mid-October, installation of machinery had not started. Production in the plant is figured to begin in late spring or early summer. With an investment of some $1.2 million, plant capacity will be 18 million brick a year.

Solite Building New Florida Plant

Southern Lightweight Aggregate Corp. based in Richmond, Va., has announced that construction of a new Solite plant at Russell, Fla., began in early October. The company has bought some 250 acres of land and has options on 2,500 at Russell, which is near Jacksonville.

A. F. Old, Solite vice president, said plant production is expected in early spring, probably in March. The company, to be known as Florida Solite Corp., will fire clay at 2,300°F. in rotary kilns, the announcement said.

Henry Brick Rebuilds, Tunnel Kiln Added

All new brick-making equipment, including J. C. Steele machinery, is being added in the large-scale modernization program under way at Henry Brick Co., Selma, Ala.

The building will include an Allied tunnel-kiln dryer combination which is an addition to their present tunnel kiln operation. The construction also has a 170 x 600′ Varco building, according to President J. D. Henry.

The dryer will be 2-3 tunnel and the kiln will be a six-wide tunnel.

25¢ Green Div.

At a meeting on Oct. 17, the board of directors of A. P. Green Fire Brick Co. declared the regular quarterly dividend of 25¢ per share of common stock, payable Nov. 18.

Bricklayers Vote To Allow Use of "Any Instruments" in Home Building

The following announcement, printed in its entirety, was received by the editors of B&CR on October 29th. Since this was on top of our press deadline, we've had no chance to add further details or comments to this announcement.

Subordinate unions of the Bricklayers, Masons & Plasterers International Union of America have freedom to test and use "any instruments" that will increase productivity in home-building, under terms of an action taken by delegates to the biennial BM&PIU convention.

The delegates' vote was cast overwhelmingly for a constitutional amendment to this effect after a number of local unions expressed interest in trying various types of "speed-lead" devices in the residential fields. Following hearings on the subject, the BM&PIU's constitution committee recommended passage of the amendment to the convention.

The type of device in question is a slotted-pole arrangement which allows guide lines to be stretched along the sides of a wall and enables masons to lay brick and other masonry units simultaneously at the middle and ends of the wall instead of waiting until the corners are fashioned. Backers of the system claim significant production increases from its use. One such device, created by the Structural Clay Products Research Foundation, has been field tested over the past several years.

The convention was held October 14 at the Ritz-Carlton Hotel in Atlantic City. A record number of 550 delegates representing subordinate unions from all parts of the country attended the five-day meeting.

"This action was taken democratically by the delegates to the convention," the BM&PIU Executive Board said in a statement issued subsequently. "It allows local option and encourages free exploration by subordinate unions to make constant improvements to the mason's trade. This should make it clear to the public that the bricklayer and the organization which serves him are sincerely interested in keeping pace with the progress of technology in the building industry. We are all interested in quality workmanship coupled with the best possible rate of production."

At the present time, a skilled bricklayer is stationed at each end of a wall to build up the corners first. A line is then stretched from one corner to another to provide an accurate guide for laying each course straight and level. The "speed-lead" device is designed to allow two poles to form the corner-guides and permit simultaneous work on all parts of the wall. A corner is formed when two sides come together.

The corner-pole assembly is one of a number of recent job site devices produced by the masonry industry to increase production, lower building costs, and save waste motion and time on the part of the skilled mason. Others include continuously-adjustable scaffolding that keeps the bricklayer close to his work and materials; packaging and palletizing of masonry units to make shipping and handling more efficient, and mechanized equipment such as fork-lift trucks, mortar buggies, and conveyor belts that move materials both laterally and vertically.

Developers of the "corner-pole" system say that field tests have resulted in wall-cost savings of up to 25 per cent. No constant figure can be advanced for anticipated savings, however, since differences in area prices, wall thicknesses, and building design create wide variances in production and subsequent economies.

Porter Expanding in St. Louis

Major investments in equipment and new products at Leschen Wire Rope Division, and expansion of the Christy Works of Refractories Division represent considerable progress by H. K. Porter Co., Inc., St. Louis, Mo., it was stated recently by T. M. Evans, Porter's chairman.

Laclede-Christy has announced a plan for expanding operating facilities at Christy Works, St. Louis, and Ottawa Works, Ottawa, Ill.

Refractory products formerly made at Laclede Works henceforth will be manufactured at these plants, as a measure to centralize operations and, in part, to move some of the production to a point nearer one of the large market areas for refractories.

The Laclede Works will continue production until late this year. Brick making operations at both Ottawa and Christy Works will be enlarged in order to fulfill customer requirements.

GLAZE OR ENGOBE

Which method are you using?

Ferro can work with you to set up techniques, processes and quality controls for either glazing or engobe . . . or for other brick coloring methods: body stains and sandblasting.

Ferro inorganic colors—developed from long experience in all kinds of brickmaking—retain color uniformity and light and heat stability through ton after ton of the brick you make.

Write today, describing your equipment, firing ranges, type of clay and proposed method of applying color.

FERRO CORPORATION
Color Division

4150 East 56th St., Cleveland 5, Ohio
5300 South District Boulevard, Los Angeles 22, California.
Ferro Enamels (Canada) Ltd., Oakville, Ontario, Canada.
Foreign plants in Argentina, Australia, Brazil, Chile, England, France, Holland, Japan, Mexico, South Africa.

Clinchfield LW Plant Ready in January

The new lightweight aggregate plant of Clinchfield (Va.) Coal Co. is scheduled to be in operation in January, producing aggregate from shale obtained from the new automated coal plant known as Moss #3. Contract for the construction is held by Link-Belt Co. of Chicago. The two plants are on the same site.

The coal plant will use the heavy media separation process for the preparation of metallurgical and steam coal. The plant is said to have one of the largest and most valuable reserves of virgin and unexploited metallurgical coal in one block remaining in the U. S. One seam ranges from 10′ to 18′ in thickness.

TexVit Expands, Adds New Joint

A product development which promises to attract considerable interest and attention in the sewer construction industry, has been announced by the Texas Vitrified Pipe Co., Mineral Wells, Tex.

The new Tex-Vit product is a rubber gasket-type, polyester joint, designed to provide a root-proof, permanently tight clay pipe coupling for sewage and waste drainage lines in both the domestic and industrial fields. Concurrent with the company's announcement to market the new product, construction contracts have been awarded for a new plant addition to be used solely for production of factory-cast joints. The new building will house the latest types of processing and assembly equipment, including mechanized handling and conveyor systems. Precision checking devices will be employed to maintain uniformity.

The new joint will be made available first in a limited range of sizes, and extended to larger diameter pipe as full production gets under way.

Scott Gissinger Dies

Scott Gissinger, 67, a director of the Medal Brick & Tile Co. of Wooster, Ohio, died of a heart attack on Sept. 28. He had been a patient in a local hospital since Sept. 9.

NEWS OF THE INDUSTRY

$Million Expansion For Carborundum Refract.

The Carborundum Co. has launched a million dollar expansion and modernization program at its Refractories Division plant in Keasbey, N. J., according to an announcement by Boyd M. Johnson, vice president of the company and general manager of the division.

Initial step in a more extensive over-all plan, the present program calls for erecting new buildings, realigning production facilities and installing new equipment. Much of this equipment will be of advanced design to serve as a prototype for subsequent requirements.

New equipment includes a 225′ long tunnel kiln embodying many unusual features; three tunnel driers equipped with individual heating, air circulating, conveyor and tamping equipment; waste-heat conservation units; and transformer units for additional power. New and larger facilities will be provided for employee shower and locker facilities. There is to be erected new mould and storehouse buildings and an addition for boiler plant facilities.

When materials are moved into the new mould and warehouse building it will open the way for realignment of equipment to improve the flow of manufacturing. The total effect of the current expansion and modernization program will be increased productivity, more orderly flow of materials and improved working conditions.

Colorado Brick Adds to Grinding Facilities

Colorado Brick Co., of Denver, has put in some $70-100,000 worth of improvements, particularly in the grinding room. A new two track 100′ dryer of their own design was put in, as were a 6′ Eagle grinder, four Leahy screens, a Meco reciprocating feeder and Dixie hammermill. The equipment, in the three plants operated in that area, will allow the company to produce finer screened clay, from 8 mesh to 16 mesh, according to Donald H. Gunning, treasurer and sales manager.

Charles A. Gunning, 73, president for 35 years, retired this year. He will continue as board chairman and business adviser. His brother, Clifford, is serving as president, with Albert Gunning as general manager.

Don Gunning reports that Colorado Brick supplied "the lion's share" of structural clay tile to the Air Force Academy in Colorado Springs.

Gladding, McBean Sales, Earnings Show Improvement

Gladding, McBean & Co.'s third quarter sales and earnings showed improvement over those of the two preceding quarters, it was announced by C. W. Planje, president. Sales volume for the third quarter increased to $8,617,000 compared with $6,489,000 for the first quarter and $7,216,000 for the second quarter. Sales of $9,642,000 were recorded for the third quarter in 1957. Total sales volume of $22,322,000 for the first nine months of 1958 compared to the record sales volume of $27,144,000 during the same 1957 period.

Net income for the quarter ended September 30, 1958 rose to $536,000 or 34¢ per share compared to $211,000 or 13¢ per share for the first quarter and $326,000 or 21¢ per share for the second quarter of 1958. Earnings for the third quarter in 1957 were $943,000 or 60¢ per share. Net earnings for the nine-month period of 1958 were $1,073,000 or 68¢ per share compared to $2,659,000 or $1.68 per share for the same period in 1957.

H. F. Dielhenn Dies

H. F. Dielhenn, president and treasurer of Massillon (Ohio) Refractories Co., died Oct. 16.

Wheeler Changes Method, Increases Capacity

Wheeler Brick Co., of Jonesboro, Ark., has reported production of face and roman red brick, a switch from their prior production of common brick.

The plant, according to President Ellis R. Wheeler, also switched from dry press to stiff mud during the past year, with an increase in plant capacity from 20,000 to 30,000 daily. The plant built a new mill room in a 100 x 32′ pipe frame building.

Cooksville-Laprairie Plans $4,000,000 Expansion

Two of the best known brick companies in Canada, The Cooksville Company, Limited of Toronto, Ontario and The Laprairie Brick & Tile Inc. of Montreal, Quebec, after many years of close collaboration, have amalgamated under the name of Cooksville - Laprairie Brick Limited. This company is a wholly-owned subsidiary of Dominion Tar & Chemical Co., Limited of Montreal.

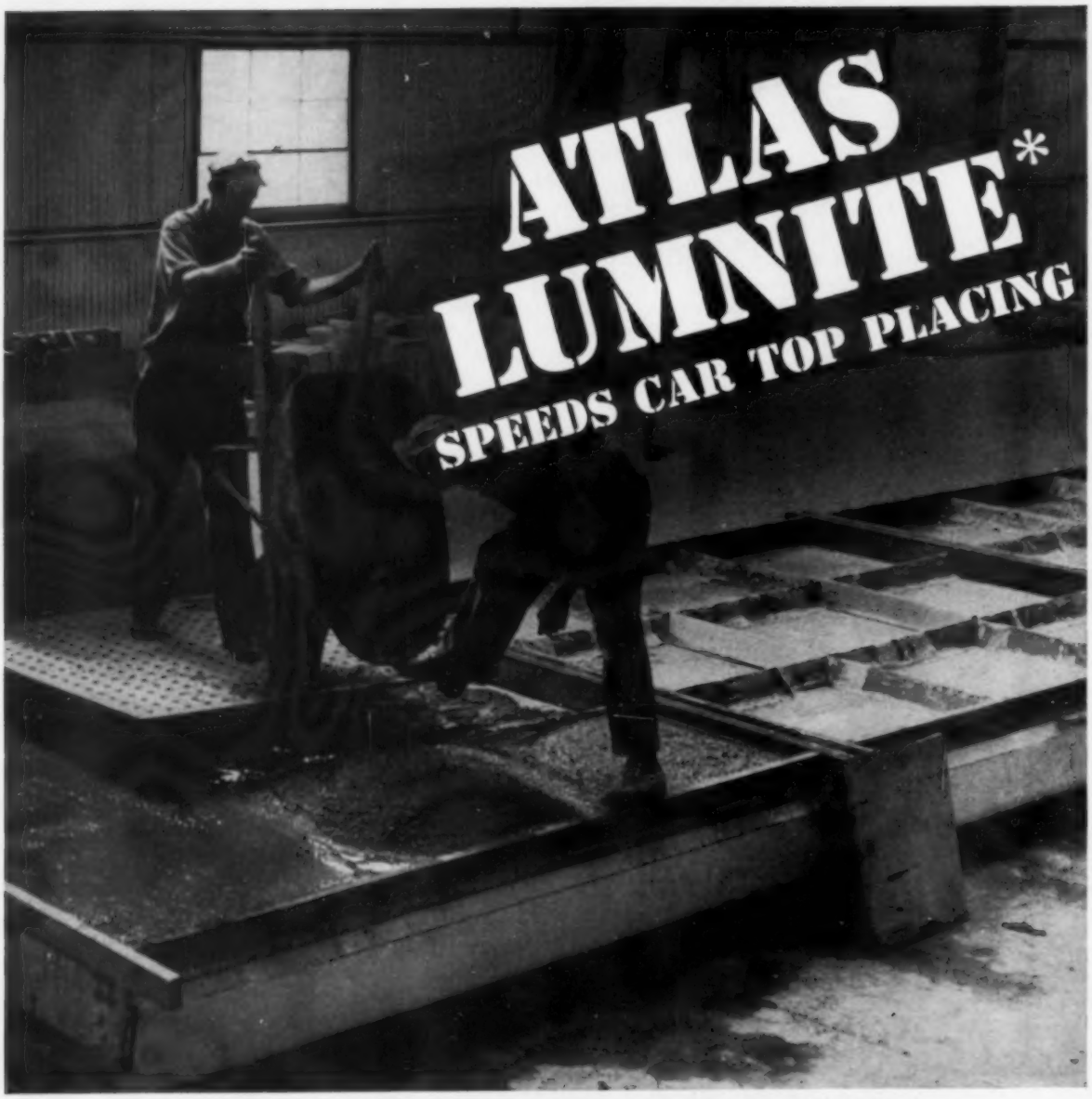
R. G. Rogers has been named Vice-President and General Manager of Cooksville - Laprairie Brick Limited, with J. J. Coffey as General Manager of the Ontario Division and R. Kenneth Robertson as General Manager of the Quebec Division.

As a first step in expanding the market of this new company, $4,000,000 will be spent on plant expansion. This will include a completely new tunnel kiln for the Ontario Division and doubling the present capacity of Plant No. 5 at Laprairie. (see July issue of BRICK & CLAY RECORD).

Upon completion of this expansion program, the productive capacity of Cooksville - Laprairie Brick Limited will be 250,000,000 brick per year. The Swindell-Dressler Corp. of Pittsburgh, will engineer the new tunnel kilns and the Robinson Ventilating Co. of Zelienople, Pa., will be responsible for the dryers.

In addition to brick, this company also manufactures structural tile, quarry tile, Haydite, acid-proof brick, pavers and blasting plugs.

The sales force of the two companies will be integrated into one so that a complete line of materials will be available to the construction industry in Canada.



Car tops being formed with refractory concrete (made with LUMNITE calcium-aluminate cement) at Clay City Pipe Company's plant in Uhrichsville, Ohio. Plant labor, using plant equipment, mixed and placed tops for 5 cars in 4 hours.

. . . refractory concrete tops cost less, last longer

- Refractory concrete tops (made with LUMNITE cement) offer greater resistance to heat and thermal shock.
- They are quickly cast in place (or precast) using plant labor and equipment—concrete reaches service strength in 24 hours.
- Monolithic refractory concrete tops also add to car stability, help reduce wrecks, require little maintenance.

For maximum convenience, use castables made with LUMNITE cement. These are packaged mixtures, ready for use. Simply add water, mix and place. Made and distributed by leading manufacturers of refractories.

Write for the "Lumnite Refractory Concrete Manual," Universal Atlas, 100 Park Avenue, New York 17, N. Y.

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NEWS OF THE INDUSTRY

New Shale-Lite Plant Begins Operation

Southern California's newest expanded shale lightweight aggregate plant, Shale-Lite Corp., has just begun operation near Chino in San Bernadino County. The plant uses one rotary kiln, as shown above. Shale-Lite officers are E. L. Chaffee, president; Arvid Johnson, vice president; Fred Elliott, treasurer; A. D. O'Kelley, secretary, with Martin Flinn as plant manager.

Three New ESCSI Members

Frank Erskine, managing director, has announced that three new members have joined the Expanded Shale, Clay & Slate Institute.

They are Norlite Products, Spokane, Wash., represented on the ESCSI board by J. K. Johnson; Clayburn-Harbison Co., Ltd., Abbotsford, B. C., Canada, with R. M. Hungerford on the board, and Rescolite Co., Fort Smith, Ark., E. J. Walsh on the board.

It also has been announced that George Collyer, president of Northern Lightweight Aggregates of Cohoes, N. Y., has been named a director on the ESCSI board.

Statement of the Ownership, Management, and Circulation Required by the Act of Congress of August 24, 1912, as Amended by the Acts of March 3 and July 2, 1946 (Title 39, United States Code, Section 233) Of "BRICK & CLAY RECORD" published monthly at Chicago, Illinois, for October 1, 1958.

1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Name	Address
Publisher, F. L. Steinhoff	Flossmoor, Illinois
Managing Editor: J. B. Anderson	Medinah, Illinois
Business Manager, Floyd M. Burdick	Elmhurst, Illinois

2. The owner is (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given): Industrial Publications, Inc., Chicago, Illinois: F. L. Steinhoff, Flossmoor, Illinois; C. R. Lacey, Downers Grove, Illinois; Maurice P. Driscoll, Oak Park, Illinois; John Van Deventer, Jr., Chicago, Illinois; James M. Lange, Chicago, Illinois; John W. Parshall, Winnetka, Illinois; J. J. Svec, Berwyn, Illinois; Frank J. Amstadter, Chicago, Illinois; Roy E. Linder, Glenview, Illinois; Marshall P. Trimble, Chicago, Illinois; Robert H. Lash, La Grange, Illinois; Sidney J. Hoganson, Park Forest, Illinois; Edward A. Reutler, Chicago, Illinois; Michael J. Skodon, Chicago, Illinois; Harold J. Sugarman, Flushing, New York; Albert S. Robinson, Roslyn Heights, New York; Floyd M. Burdick, Elmhurst, Illinois; Karl H. Clarke, Chicago, Illinois; William J. Salmon, Chicago, Illinois; Ernest G. Schau, Flossmoor, Illinois; Robert C. Reschke, Highland Park, Illinois; Avian L. Schaefer, Chicago, Illinois.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)....None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and condition under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only).

Sworn to and subscribed before me this 19th day of September, 1958.

Floyd M. Burdick, Business Manager

Karl H. Clarke,

(Seal)

(My commission expires October 21, 1960.)

Grefco-Canada Names Shonk, Moorecroft

Ralph A. Shonk has been promoted to vice president and general manager of the Smithville, Ont., works of General Refractories Co. of Canada, Ltd.

Fred A. Moorecroft has been appointed assistant treasurer and secretary.

Shonk, a ceramic engineer, has been Smithville superintendent since the installation opened in early 1957. Moorecroft has been with General for a year. The company is a wholly owned subsidiary of General, with parent offices in Philadelphia.

Worthington Ceramics Joins CFLI

Membership in the Clay Flue Lining Institute has been increased to 10 manufacturers with the affiliation of Worthington Ceramics, Worthington, Pa. Worthington Ceramics is a division of the Logan Clay Products Co.

Announcement of Worthington Ceramic's affiliation with Clay Flue Lining Institute was made by C. L. Meanor, president of the Institute. J. G. Frantz has been named to the board of directors of the Institute, representing Worthington Ceramics.

Robinson Markets Magna Tile

Robinson Brick & Tile Co., of Denver, has completed arrangements for marketing in the western U. S. a thin ceramic veneer called Magna-Tile, made by Stylon Corp. of Milford, Mass.

John E. Ryan, of Robco's ceramic veneer sales division, says Magna-Tile is used for interior and exterior facing, can be installed with either mastic or mortar and comes in 15 matte glaze finishes.

Stylon also makes Robco's new 3/8" Vitrineer.

A. S. Staples Dies

Alvah S. Staples, former Hudson River, N. Y., plant operator with a plant at Malden, died at the age of 85 on Oct. 7.

NEWS OF THE INDUSTRY

Va. Brick Assn. Reactivated

The Virginia Brick Association, with E. J. Meredith as executive secretary-manager, has been reactivated, with offices at 112-114 Exchange Bldg., in Richmond.

Membership consists of Appalachian Shale Products Co. of Marion; Brick & Tile Corp., Lawrenceville; General Shale Products Corp. of Richlands; Locker Brick Co., Glasgow.

Also, Old Virginia Brick Co., Salem; Redford Brick Co., Richmond; Roanoke-Webster Brick Co., of Webster, Suffolk and Somerset; Southside Brick Works, Richmond.

Officers, besides Meredith, include G. N. Redford, president; Frank J. Stumpf, vice president; Miss Louise Vaughan, treasurer.

The purpose of the association is to promote the use of brick to architects, engineers and contractors in all of Virginia except the northeastern part, Meredith says. The promotional program will begin this coming February.

Dixie Fire Brick Adds Buildings, Equipment

Two new Varco buildings, one 100 x 80′ clear span for finished brick storage and the other 60 x 80′ for calcine storage, have recently been added at Dixie Fire Brick Co., Birmingham, Ala.

According to John W. Lewis Jr., president, the firm has also added a system of monorails for handling cutter reels; mould boxes for represses and mouthpiece dies have been added in the last six months. An A. H. Emery Co. load cell has been put in to allow batch weighing of raw materials.

Denver Fire Clay Building Laboratory

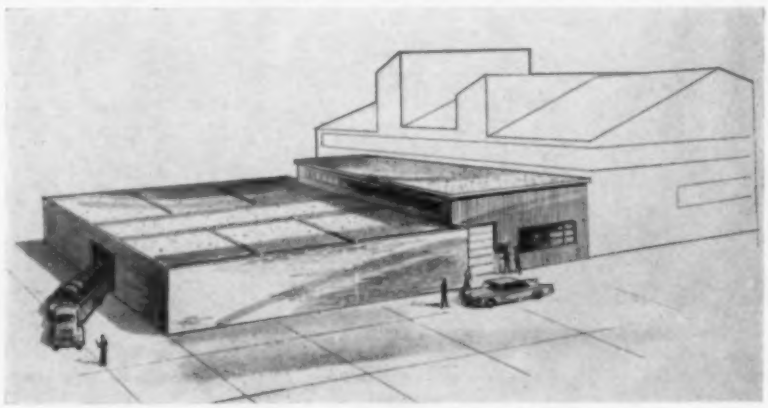
A new 1,350 sq. ft. laboratory is under construction at Denver (Colo.) Fire Clay Co., to provide facilities for research on the development of refractory products. Some $50,000 will be spent on the program.

The lab facility, company officials say, is the first step in a long-range expansion program. It will be used for the development of new products in the metallurgical field, in steel production plants, rockets and missiles, nuclear processing and government work. William O. Brandt, research director, heads the program.

Carborundum Names Robert Straka

Robert C. Straka Jr. has been named manager of special products engineering by the Refractories Div. of Carborundum Co., Perth Amboy, N. J.

$300,000 Construction Replaces Fire Loss at E&H



Architect's drawing of new W. S. Dickey building in St. Louis, scheduled for completion in February, 1959. Housing six modern, individually heated clay pipe drying rooms and a large press room, this new structure is one step in Dickey's long range plans for the St. Louis area.

Shipments sufficient to fill all orders are continuing at the Evens & Howard Division, W. S. Dickey Clay Mfg. Co., despite the toll taken by a recent fire.

"We're working 'round the clock to maintain production at capacity," J. J. Stencken, general manager, pointed out. "Assistance in maintaining a complete yard inventory is being provided by six other Dickey plants," he said.

Temporary business offices have been established at 2395 Hampton Ave., St. Louis. Orders also are being taken at the plant site. The temporary office telephone number is MIssion 5-7260, and the plant telephone number is MIssion 5-3420.

Only 25% production capacity was lost in the fire. Although the flames destroyed a four-story block long structure, housing drying facilities and offices, most of the dies were saved.

Two new buildings—a plant addition and an office building—will soon rise to replace the old structure. Contracts will be let in October for the new $300,000 plant addition. It will be located at 5200 Manchester Ave. Ground-breaking is slated for early November, and completion is scheduled for February, 1959.

The new one-story building, of steel and masonry construction, will be 130x157′. It will be used for the manufacture of clay pipe, as well as a complete line of fittings.

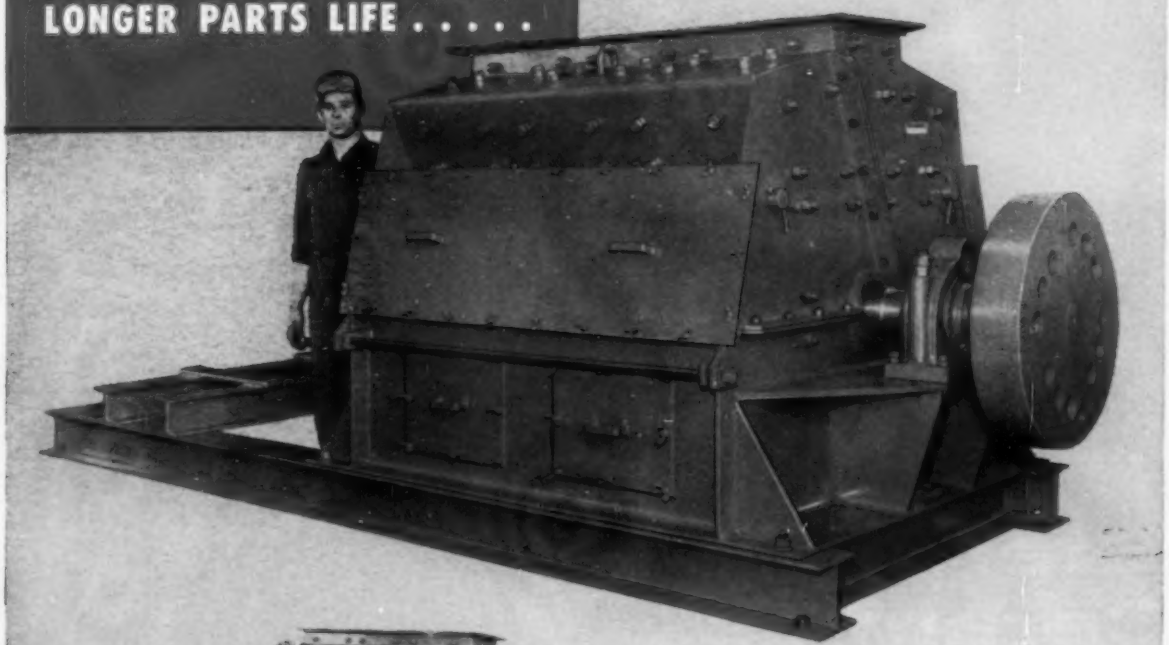
Two new Pearne & Lacy horizontal extrusion machines for making pipe in diameters of 4″ through 12″ will increase the range of pipe sizes to be produced. They will be located in a 50x115′ press room. Other pipe sizes will be made by the vertical extrusion process.

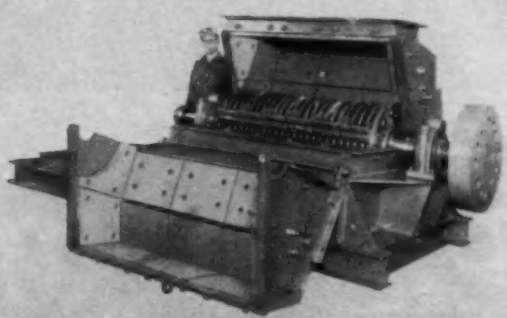
Also located in the new building will be six drying rooms, each of which will be 38x58′. The new room-type dryers feature individual gas and oil fire burners, and will have steel grating floors. Their use will reduce drying time by 20%.

New dies and motorized equipment required for the new plant are now being produced in other Dickey plants.

NEW DUAL "2-POINT" ADJUSTMENT INSURES MORE UNIFORM GRINDING, LONGER PARTS LIFE . . . . .

WILLIAMS *Reversible* HAMMER MILLS





Williams Reversible Hammer Mill with cover open. Note these features:

- Super-strong reinforced steel plate frame
- Renewable wear-resistant manganese steel liners
- Heavy duty oversize forged steel rotor shaft
- Anti-friction self-aligning roller bearings in dust-tight housings
- Complete accessibility to interior for quick parts changing

It's another Williams "first"—features not available in other hammer mills—that now makes it possible to maintain the original close clearances of *both* grinding plates *AND* cage sections against the rotating hammers. This easy-to-make "2-point" adjustment, in the most critical grinding area inside the hammer mill, gives absolute assurance of consistently uniform product quality.

In addition to the advantages of the Dual "2-Point" Adjustment, a Williams Reversible Hammer Mill substantially lowers upkeep expense by cutting hammer cost. Hammers can be operated in one direction today and another tomorrow simply by installing a simple reversing switch on the driving motor. Manual reversing of hammers no longer necessary. Grate bars also last longer. The double set of reversible manganese breaker plates, which last twice as long as other types, give four times the service! Maintenance and downtime are cut 50% or more.

Get all the facts about the hammer mill with *ALL* the top features.

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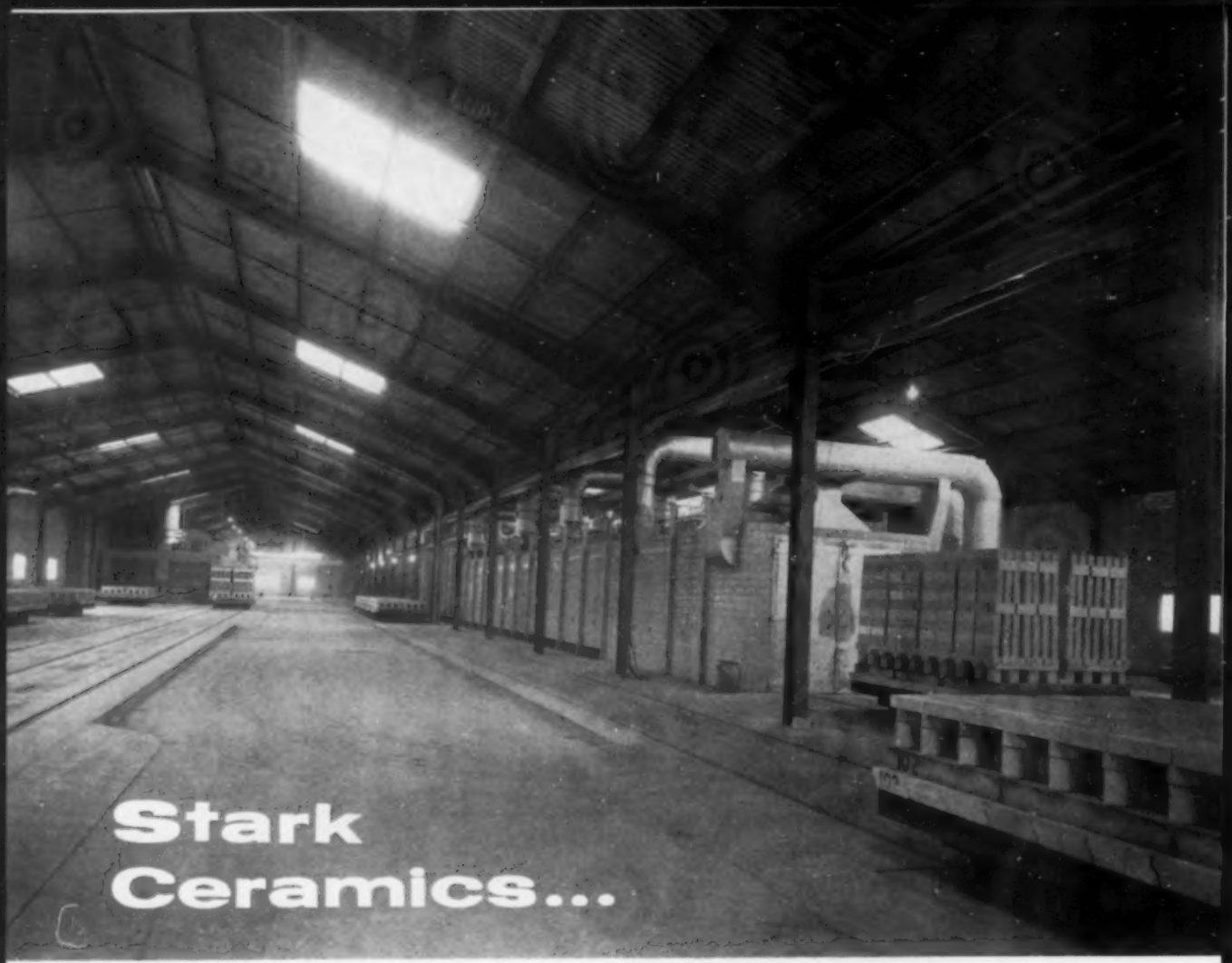

Their First Tunnel Kiln Increases Glazed Tile Output 20%

Three-unit plant—with 44 periodics—has giant pit operation with three draglines; plans new machine room to supply tunnel kiln; company makes own machinery, built plant addition using glazed tile throughout.

Stark Ceramics, Inc., makers of brick and tile since 1912, and one of the nation's early producers of colored ceramic tile, continues pioneering with the building of their first tunnel kiln, designed to ultimately take green ware directly from the brick machine to be set on tunnel kiln cars for drying and firing.

The new additions to plant capacity increase annual production some 20% from 50 million brick equivalent to some 60 million. Using 44 periodics prior to current expansion, all will be retained and machine room capacity will now receive attention from the management in an attempt to maintain a supply equal to the new requirements.

While the Swindell Dressler kiln represents some important firsts in the firing of glazed tile, the entire Stark plant is of high interest both in the sheer size of the operation and the methods developed by trial and error over the years to meet the difficult problems associated with the production of a product which has the highest quality requirements of any structural clay material.

Three Pits Mined

The story of quality starts in the pits and continues through grinding, forming and firing. In order to eliminate, as far as possible, variations in raw material three

separate pits are mined for the high grade fire clay used in the body. A proportion of clay is taken from each pit, blended, and stored.

A typical pit requires the removal of 65 to 70 feet of overburden before the loading shovels can get to the quality clay. For this service the mining division uses three drag lines, one equipped with a bucket of over three yards. The first 35 feet removed is top soil and shale, which is underlaid with three feet of coal. This coal, known as 6# coal in the Canton, Ohio, area, is removed with shovels and sold to local industries, as all firing is with gas, or oil standby during periods of gas curtailment.

Following the removal of the first seam of coal, 27 feet of #6 clay and shale are stripped out and dumped as it does not meet the requirements of the plant. Twenty-two inches of #5 coal thus exposed is taken out and, like the first seam, sold to help recover the cost of exposing the #5 fire clay which is used. The #5 clay runs in a strata that ranges from six to twelve feet in depth.

In addition to the three drag lines used in the pits, six loading shovels are operated. Four dozers are required for housekeeping, roadbuilding, stacking and other odd jobs about the pits. These machines range in size from a small Cat D-4 through a D-7, D-8 and D-9. Hauling is handled with seven dump trucks all equipped with five yard beds.

Clay Testing Program

Over the years many pits have been opened, worked and depleted. Three men are assigned to stripping, exploration and proving. Three days a week this crew drills for testing or to put down blast holes. The testing program calls for a sampling of all clay some time prior to its use and requires the drilling of three-inch holes for samples for the lab. Six-inch holes are used for the placement of explosives in the working face of the pits.

The average haul from pit to plant is about two miles. Each truck load of clay is weighed on its way to the plant and its source and disposition is logged for reference.

The three man ceramic lab makes a continuous check of the incoming clay to insure that it actually follows the quality forecast made from the test samples prior to its removal from the pits. Each pit is being worked in the same strata but the effect of local variation is minimized by working from three sources at all times.

Blend Before Grinding

Blending of the three clays is accomplished before the clay has been ground and delivered to the storage bins. Reciprocating conveyors spread each incoming load of raw material over the entire area of the storage bin, thereby blending not only clay from each pit but diluting the effect of each truck load on production at any given instance.

Three Plant Units

Over the years, as capacity has been increased at Stark, the operation has been departmentalized and now consists of three units, A, B and C. Units A and B are self contained, each capable of producing glazed tile from grinding to dry ware ready for the kiln. Unit C is the newest and consists of the tunnel kiln and takes dry tile from Unit B for processing in the kiln.

While production of certain types of tile are assigned to each unit and some operations therefore vary from unit to unit, grinding in both A & B is practically identical in practice, although certain pieces of equipment may vary in size and make from one plant to the other.

In plant A, incoming clay is dumped into a 24x48" McLanahan roll crusher for preliminary crushing and

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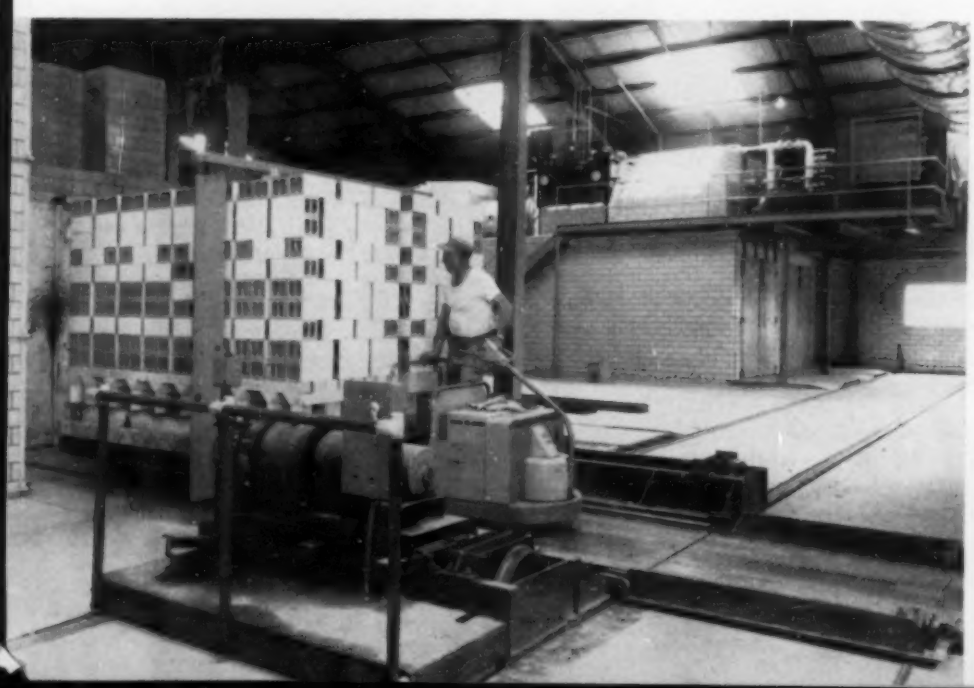


Plant designed track connector was built to smooth transfer of car from one track to another without jolting car.

Glazed surface product requires open setting.

STARK CERAMICS Continued

further size reduction is made with an 18x36" roll crusher. Reciprocating feeds controlled by Bonnot electronic dry pan controls carry the output of the second roll crusher to two ten-foot Bonnot drypans. These controls, by sensing the current draw of the driving motors, maintain a drypan charge within rather narrow limits that will produce maximum grinding production. If material conditions change, the charge level can be varied to accommodate the changed condition by simply changing the setting on the control.

Six Screens

Six screens are used to size ground clay. They are supplied from the drypan discharge with a bucket elevator and are in closed circuit with the drypans. Grinding is fine with only material passing a 20 mesh being conveyed into the storage bins. The screens are vibrated Link-Belt and have been electrified. Stark Ceramics have found that, due to the fine size of their grinding, heated screens are a practical necessity. The plant engineers were among the first developers of this screening technique with the first conversions being made with A.C.F. transformers in 1938.

Plant A has storage arranged into three bins, each holding about one day's supply. The practice is to fill one bin completely while using from the other and on the following day to reverse the procedure to insure a thorough blending of clays.

Blended clay is taken from the bottom of the bins with belt feeders and delivered to surge bins in the mill room from which variable speed belt feeders take the clay to combined brick machines used in A unit. Two of these machines, updated Riddells, are used for the production of all soaps, 4D size and 6T vertical cored tile.

The third machine is a FRH, used for the forming of all machine-made shapes and slugs for the hand-made shapes. This third line is equipped with a plant designed and built cutter with the whole line being laid out with speed of die change and flexibility of operation the major consideration. The two Riddell lines use Bonnot cutters that cut the column after glaze material, prepared in the glazed department, has been applied to the column immediately following extrusion.

Wet Spraying Reduces Culls

Offbearers set the sprayed tile on dryer cars which are moved to one of the 56 dryer tunnels of unit A. A typical drying schedule requires one and one-half to two days before the tile are dry enough to be set in kiln. According to plant personnel, wet spraying, by eliminating one handling of fragile ware, reduces cull material. Over 700 dryer cars are used in unit A alone and when the tile are ready for setting the cars are removed on four car transfers to the kilns. The dryer is set up to use waste heat from cooling kilns. The total heat input can be boosted with a steam heating system when adequate waste heat is not available.

The small line used for production of slugs for the hand-made shape department uses an FRH line located so that the clay slugs move on cars directly to the men making the complex shapes. A repress is used to form the piece. Then the finishers remove the mold marks and smooth the piece to the proper condition before it is dried. After drying, the piece is taken to the manual spray booths where the ceramic glaze material is sprayed onto it.

Fast Replacement Service

A stock of unglazed fired "bisque" pieces of each of the complex shapes is maintained in order that the orders for small quantities of the vital shapes can be shipped to replace car and job breakage. By glazing the prefired units and firing them in the first available kiln the company can ship replacement pieces days earlier and the resulting customer satisfaction is regarded as being well worth the extra cost.

Backing up the production teams of units A and B, the glaze department formulates glazes from raw materials which, after being checked by the laboratory for color and fit, is delivered to the spraying booths on the millroom floor. Two men are used in glaze preparation.

All Glaze Checked

The incoming glaze raw material, having been checked by the lab for conformance to specification, is taken by the glaze preparation department, compounded into the formulae developed over the years, and ground in one of the seven ball mills used by the department.

Besides its important duties in control of glaze quality and incoming raw material, the laboratory also maintains a watch on the acidity of clay being used in the millrooms and, when found to exceed specifications, directs and controls the use of additives to bring the pH into line. This innovation has been found to have important effects on the quality of the final recovery of first grade material.

Unit B uses only one roll crusher, a 18x36" McLanahan, prior to delivery of clay to two nine-foot drypans. These, one Stevco and one Bonnot, move clay to apron feeders with electronic controls and are followed with a six-unit screen layout similar to that in the first unit.

The same fineness of clay is used although the storage facilities are different. One clay bin is served by a Case overhead crane while the other, a recent addition, uses shuttle conveyors to secure the desired intermixing.

The B unit uses only two brick machines. These are updated Riddells, as in the other millroom, and are deaired as well as being equipped for pH control and pugging water control. Each line uses a Steele cutter but here the glaze is sprayed onto the wet tile after they are cut, instead of before as in unit A.

Less Die Changing

Used for the production of all horizontal cell 6T size tile the B unit is not required to make the multitude of sizes and shapes and consequently longer runs are possible without die changes. Here, too, the sprayed green tile are set onto the dryer cars for further handling.

Dry tile are taken from unit B and delivered to the new tunnel kiln for firing. Both A and B units furnish tile for setting in the plants 44 periodics. These kilns are a mixture of 32 and 30 footers. Close attention to the periodic firing schedules has been used as a basis for the design of the tunnel kiln. Setting patterns required by the glaze coat limit the tonnage of each periodic setting to 60-80 tons depending on the size of ware being fired. Using a burning range of from 2050° to 2080° for all ware the schedule has been the subject of an intensive study project dating back some 12 years.

At that time, kilns were turned off 120 hours after being lit. Gradually this has been improved until now the schedule calls for kilns to finish after about 60 hours. Periodic kilns, like the tunnel, are fired with gas. They do not have stack boosters but rely on natural stack draft. All colors mature at the same temperature and can be mixed in the same kiln with no sacrifice of quality in any way.

In order to eliminate culls produced in handling, tile are graded in the kilns, packed in separators and delivered to inspection stations for final checking before being shipped on the order.

Tunnel Kiln Nearby

When plans were made to add the tunnel kiln to the firing capacity of the plant, it was decided to take dry tile from the B production unit at first and to work out the best possible firing and handling techniques before installing forming machinery for the new addition. With this principle in mind, the location of the tunnel kiln building was set so that only an 80-foot transfer is required to move the dry ware into the hacking station of the C unit. The connecting building, now used for the transfer, was built of sufficient size so that the millroom could later be installed and streamlined material flow maintained.

Site clearing and construction of the 540x124′ main building was done by plant personnel with the only outside contract being that for the building of the tunnel kiln by

Continued on next page

Skilled manual fettling operation removes die marks from repress shapes.

STARK CERAMICS Continued

Swindell-Dressler. In addition to the main structure, storage buildings 220x95′ and 220x62′ plus the 40x70′ millroom were built.

Feeling that a major tile producer could not afford to use less than the best, all of the buildings were built with 8″ walls of commercial grade glazed tile. The walls are 18′ high and present a glazed face both inside and out. A light shade was selected which results in a very high light level inside the plant, with plant housekeeping reduced to a minimum. Over 300,000 tile were used in this construction. Plant management is enthusiastic over both the reasonable cost of this type of construction and the exceptional appearance.

Ample Lighting

The roof was built with asbestos cement panels on Luria rigid trusses with 62′ of clear span on each side of center posts. Plastic skylights give a high level of natural illumination and this is supplemented with fluorescent lighting with especially high intensity in the loading and unloading station area.

Dryer cars are brought into the car loading section, the tile set from the dryer cars onto the tunnel kiln cars which are moved directly to the tunnel dryer. This unit is actually being used as a pre-heater instead of a dryer at present, although when the millroom addition is complete it will function as a dryer with glazed green ware being set directly from the offbearing belt onto kiln cars.

Cars Are Underfired

The tunnel kiln cars are 7′3″ x 9′2″ long, and the ware setting is 11 courses high on the cars. The cars have been equipped with Timken sealed bearings with lubrication being required infrequently. The cars are underfired with great care being taken to keep the superstructure clean and level to eliminate damage to ware. The plant engineers have designed track connectors to prevent jolts to the loaded cars when the car is moved from transfer car to tracks.

The dryer is double tracked and is 149′ long. Heat is taken from the cooling zone of the kiln for drying air while four fans on the dryer maintain circulation for both temperature and humidity curve control. A fifth fan on the dryer is used as the exhaust fan. Used as a preheater, the dryer has the automatic humidity controls removed from service.

The tunnel itself is 315′ long with four automatic control zones in the furnace section. The first 86′ of the kiln is used for preheat and is manually controlled. The temperature curve is manually controlled with excess air burners, preheat burners and hot clean air bled in from the air duct running from the rapid cooling section of the kiln.

This clean air is introduced at the end of the preheat zone and at the cool end of the furnace zone to depress the temperature gradient at this point. An automatic damper control maintains a slight draft in the kiln and controls the flow of kiln gases through the furnace and preheating zones to the exhaust fan.

Burners and Controls

The 12 excess air burners are North American with atmospheric air being inducted while the preheat burners are manifolded aspirated burners. The furnace sections are premixed gas and air mixed in a North American inspirator. The four sections of the furnace are controlled by a bank of Brown ratio recording controllers with a plus or minus 10° maximum variation.

The exit end recirculation system and two point removal of heated air at the rapid cooling section and the ware cooling section together allow a high degree of control over the cooling curve, which compares with the flexibility of the preheat and furnace zones.

The kiln uses Robinson and Garden City fans, a Denison car pusher and multipoint Brown recorders for thermocouples.

Car With Couples

An interlock time delay on the electrical service prevents the kiln from being shut down due to line fluctuations, throwing the circuit breakers. One feature of the kiln is a regular tunnel car that has been equipped with a set of six couples. This car is used as a production car and is in the kiln on the regular car schedule loaded with the standard setting of tile.

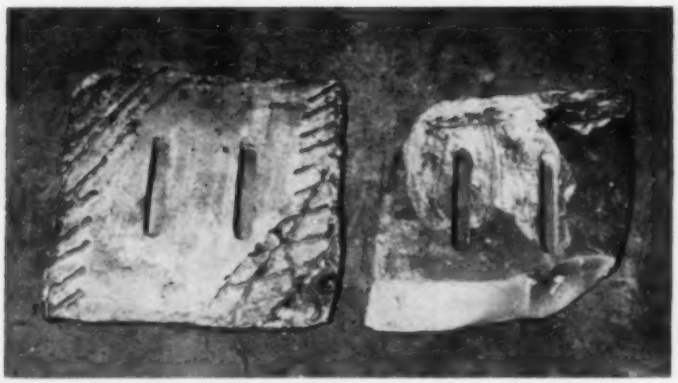
The six couples are placed in different parts of the setting and attach with a 7-wire trolley system so the temperature at each couple is recorded on a six-point multicolor recorder.

With this accurate tool the plant management can determine the average burning condition in all parts of the setting and correlate results obtained with the actual temperature curve as well as check on how the actual curve compares with the designed curve.

On a two-hour schedule, the transit time runs just over 60 hours. In practice, this has been found to give a high recovery of first grade material. The shape of the firing temperature curve is practically identical with those obtained in the periodic kilns although the actual firing time runs to less than half of the periodics.

The tunnel kiln is not equipped with any standby fuel, using only natural gas, although the periodic kilns are set up to use oil during gas curtailment and the plant has a 42,000-gallon tank for storage. It was felt that the com-

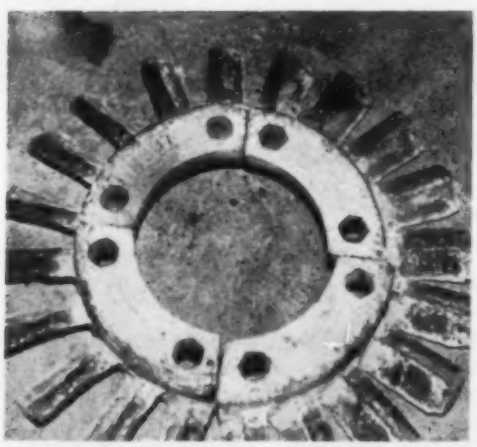
Continued on page 79



MULLER PLOWS—*Note how Tube Borium (left) has retained corners and size under severe abrasive action.*

"What... **TUBE BORIUM*** *cheap at $5.00 per pound?"*

AUGER PADDLES
Tube Borium keeps paddles out to size, improves auger efficiency in moving wet clay.



SHREDDER KNIVES—*A small deposit of Electric Tube Borium keeps knife edges sharp and straight.*

Some people buy hard-facing metals strictly on price. Real economy is measured—not in first cost—but in results. That's why TUBE BORIUM is cheap at almost any price. TUBE BORIUM virtually defies wear. It not only outlasts all other hard-facing alloy types on applications involving straight abrasion but eliminates downtime usually required for maintenance. With negligible downtime valuable production is saved. In addition to lower cost of operation you'll notice all equipment produces at a higher rate because parts keep original size longer, retain operating efficiency!

One of your biggest investments in any hard-facing program is not the alloy used but the welding time expended. It takes no longer to apply the best alloy than the cheapest—but results are beyond compare. Next time try Stoody TUBE BORIUM. In the long run, you'll find it more economical—even at $5.00 per pound!

*__TUBE BORIUM__ is pure Tungsten carbide particles encased in mild steel tubes. Abrading surfaces protected with Tube Borium slide on a layer of tungsten carbide, the most wear resistant metal known. Available in a wide range of mesh sizes for acetylene or arc application; also in wires for automatic and semi-automatic electric welding machines.

STOODY COMPANY
11950 East Slauson Avenue, Whittier, California

Photo courtesy of The Robinson Clay Product Co.

How Petalite extends refractory life

of kiln car tops at Robinson clay

By utilizing the unique thermal properties of petalite, The Robinson Clay Product Co. and other refractory manufacturers are now able to make *kiln car tops that have an extended service life up to two years . . . and more!*

Application tested in tunnel kilns under severe heat shock and loading conditions, Robinson Clay R-100 car tops made with petalite have demonstrated *unexcelled thermal shock resistance and high-strength properties.* They have lasted *five to eight times longer* than car tops made with more expensive conventional materials.

In the three years that R-100's have been used at Robinson Clay, they have saved the company an estimated $40,000 in replacement costs. Based on this successful application for their own use, Robinson Clay is now offering similar mixes in a broad line of kiln car furniture for use in the ceramic industry.

Discover *first hand* the enormous possibilities of petalite as a ceramic material. Get to know petalite as well as you know the clays, flints, and spars. Work with it . . . analyze its properties . . . see how many advantages it can bring to your products.

Samples, technical literature, and application assistance are yours for the asking. The general story, given in Bulletin 301, will get you started. Write, the Technical Literature Department, Foote Mineral Company, 442 Eighteen West Chelten Building, Philadelphia 44, Pennsylvania.

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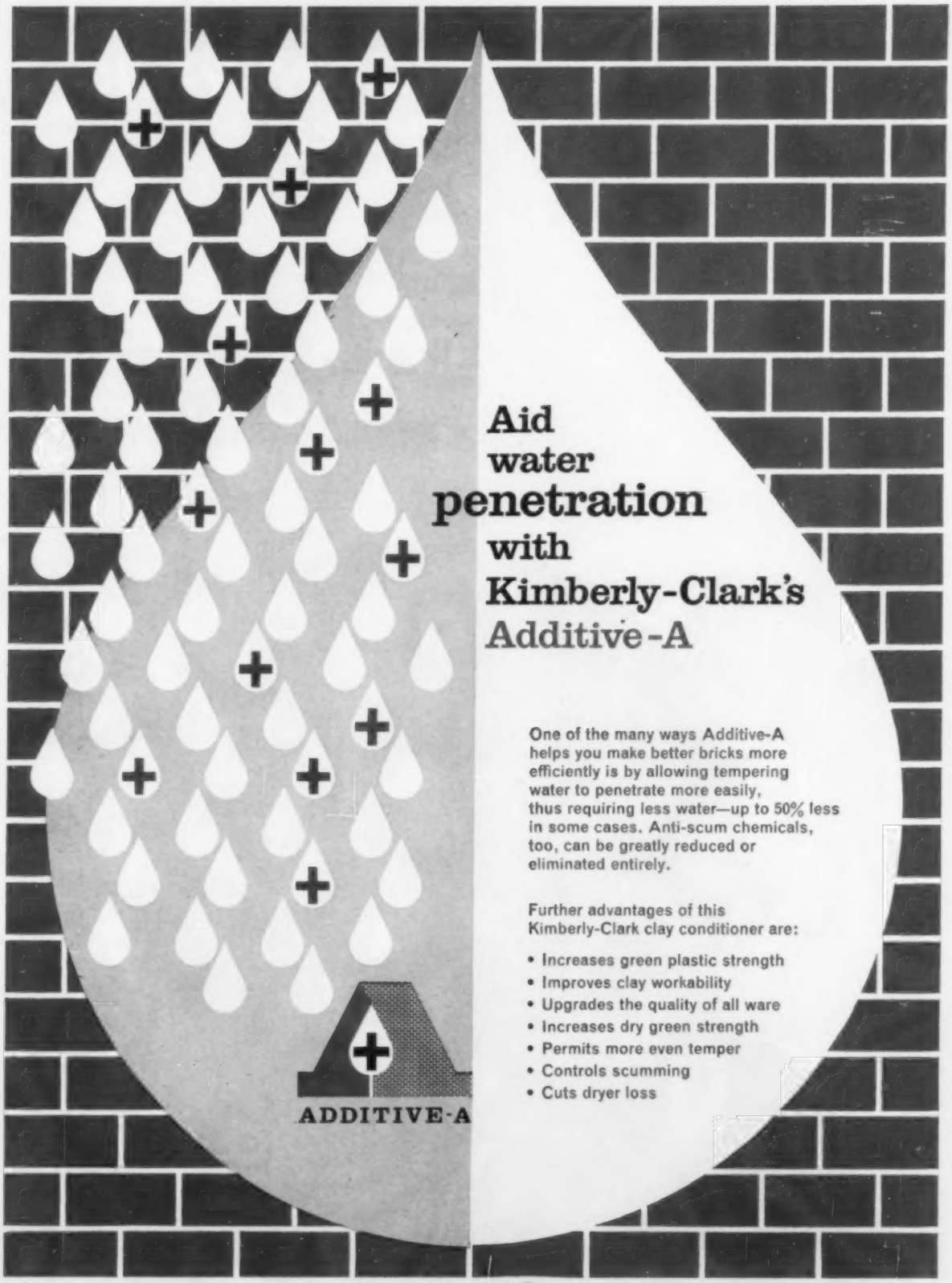
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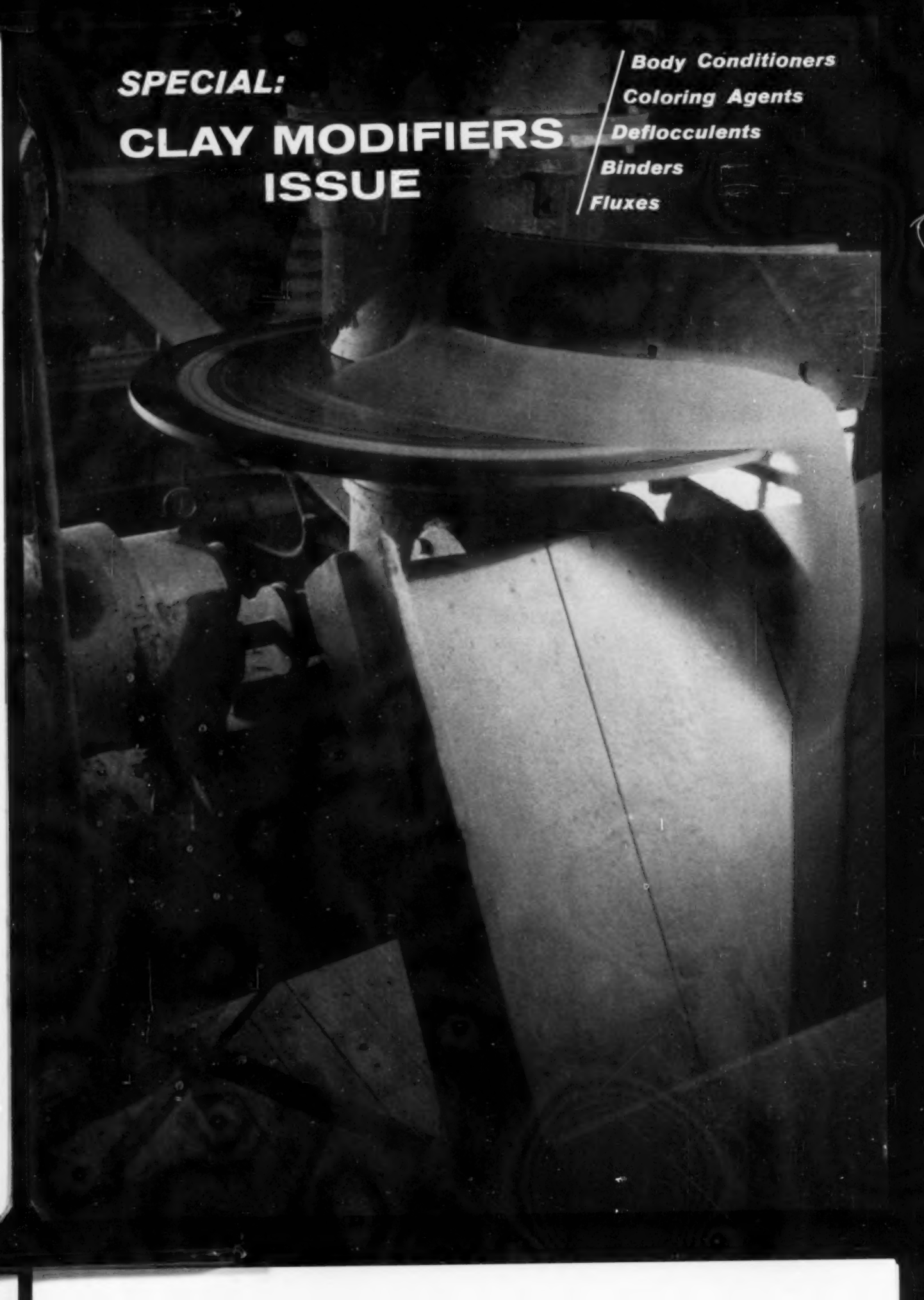
SPECIAL:
CLAY MODIFIERS ISSUE
Body Conditioners
Coloring Agents
Deflocculents
Binders
Fluxes

Clay Modifiers

Available to the industry for the first time, the editors of BCR have compiled a complete, concise summary of materials that you can use to control: firing, drying, forming, texture, color, porosity, weight, strength and size.

Albany Slip Clay

A low fusion point clay with a PCE of 3-5. The standard material comes from West Albany, N. Y., and gives a brown glaze. Its application in structural clay is principally for the interior glazing of sewer pipe. For such use it is slurried and applied by spraying or dipping. It has also been used as a flux and color stabilizer in quarry tile. The clay is available in lump and airfloated form.

Alumina

Al_2O_3. A material appearing in several crystalline forms, of which alpha-Al_2O_3 is the densest and most stable. Native alumina is found as the mineral corundum, having a hardness of 9.0 on the Mohs scale, and long used as an abrasive and for jewels as ruby and sapphire. The hydrated phases, gibbsite, diaspore and boehmite are also found in nature.

Although alumina occurs commonly combined as silicates in clay, feldspar, kyanite and many other minerals, the principal sources of purified alumina and hydrated alumina are native bauxites and laterites from which large tonnages are extracted annually by the Bayer process.

Bayer aluminas are available in a wide range of physical properties mainly as a result of control of crystal size and chemical reactivity during their formation. Their high purity with respect to iron and fluxing impurities make them suitable for many ceramic applications in the refractory, abrasive and alumina porcelain fields.

Four types of alumina are generally considered for use in ceramic products: They are Calcined, Tabular, Fused and Hydrated aluminas.

Fused alumina is produced in large tonnages by an electrothermal process from bauxite and Bayer alumina for abrasive purposes, and although it is exceeded slightly in hardness by silicon carbide and some other synthetic abrasives, it is superior in toughness and is recommended particularly for metal grinding.

The addition of alumina to fireclays increases refractoriness, load-bearing ability and spalling resistance. A new type of high temperature insulating refractory is made from fused alumina bubbles, or hollow spheres, bonded and high fired.

This material is supplied as a castable which can be formed into the desired shape on the job and provides protection up to 3300°F. Calcined alumina and bauxite as well as tabular alumina grog are used in large tonnages to increase the alumina content of refractories. Calcined, sintered and fused aluminas constitute the base materials in a class of special refractories containing from 90 to 99% alumina, used in the form of refractory brick or monolithic liners.

Calcined alumina is added to native kyanite to adjust the alumina-silica ratio during conversion to mullite. High purity synthetic mullite is produced from alumina and low iron clay, mixed in suitable proportion to form $3Al_2O_3{\cdot}2SiO_2$ and converted by sintering or fusion. A synthetic, high-temperature, thermal insulator has been developed recently which consists substantially of mullite in fibrous form.

Alumina is used in producing refractory calcium aluminate cements which set by hydraulic bonding. In rammed and castable compositions with refractory grogs, these cements retain good bonding strength in their effective service range. Calcium aluminate cements, prepared from Bayer alumina, may have pyrometric cone equivalents above 35.

High alumina bodies exhibit great resistance to mechanical abrasion in addition to their more widely used resistance to heat. In some formulations the service life of these materials exceeds that of hardened steel by 30-50 times.

In glazes, alumina is the means for regulating the oxygen ratio to control matteness or brilliance. The best aluminate silica ratio in conventional glaze has been found to be between 1:6 and 1:10. In glaze containing at least 0.1 equivalent of alumina, the further addition of alumina raises the deformation or maturing point. An important function of alumina is its prevention of glaze devitrification. It increases viscosity, refractoriness and opacity. In general, it increases the resistance both to chemical attack and impact resistance, tensile strength, hardness and weathering. The chief sources of alumina equivalents for glazes are feldspar and clay.

Ammonia

NH_3. This material can be used to control the pH of clays. Where the high acid condition of a naturally occurring clay is such as to cause trouble in the dryer, especially with peeling glazes, ammonia can be added to the pugging water to control the condition. Two forms are available, the anhydrous, a gas sold in drums. Ammonia Hydroxide is a liquid and is available in cans, drums or carloads. It has been found that additions of ammonia also will affect black coring and, if the problem is not too severe, will control it. Scumming is also affected when not too severe. The pH appears to be best adjusted between five and ten.

Ammonium Chloride

NH_4Cl. One of a group of materials which, by affecting the temperature of the dissociation of the sulphur compounds occurring in structural ware clays, can effectively reduce the time required to fire ware without black-coring. Due to the corrosiveness of the compound the problems connected with its use have been overcome with the addition of ammonia and ammonia bicarbonate. However, according to a patent, U.S. #2,838,410 assigned to the Spencer Chemical Co., the more effective treatments consist of application of up to .2% of a solution of Ammonium Nitrate and Ammonia or Ammonium Bicarbonate. Other combinations are said to be effective in the elimination of black coring.

Ammonium Nitrate

NH_4NO_3. (See Above)

Andalusite

$Al_2O_3{\cdot}SiO_2$. The same chemical composition as sillimanite and kyanite with which andalusite forms a trimorphic series. Andalusite is orthohombic, has a specific gravity of 3-3.5 and a hardness of 7.0-7.5. Special varieties are known as Chiastolite and Viridine.

As mined for commercial use, the ore generally contains 75-85% andalusite. Minor amounts of pyrophyllite, mica, rutile and corundum are frequently present as associated minerals. The andalusite now mined in the United States comes from White Mountain in the Inyo range, Mono County, California. Deposits of commercial grade andalusite discovered to date are relatively rare, but reserves of some promise are found in Nevada, New England, Brazil, Australia, Sweden, France, Russia, Germany and Spain.

Andalusite has been used principally in spark plug porcelains and special refractories for high temperature service. The current and potential uses are limited by its availability. Along with kyanite and sillimanite it is promising as a mullite forming mineral. Andalusite, if available economically, would often be preferred for mullite type refractory bodies, since its volume stability, refractoriness, and ready conversion to mullite are desired characteristics.

Anhydrous Rasorite

An anhydrous sodium borate concentrate containing approximately 90% Na_2O, B_2O_3 and 10% of a complex insoluble clay. An addition of 6% of this material to salt used in salt glazing sewer pipe and facing materials will increase glaze thickness, reduce pinholing and crazing and generally improve the appearance of the pipe. It offers a more economical source of B_2O_3 than the refined sodium borates and can readily be substituted for either borax or anhydrous borax on an equivalent basis. (59 pounds are equivalent to 100 pounds of the hydrated borax and 111 pounds are equivalent to 100 pounds of the anhydrous borax.) The constituents contained in the insoluble clay are silica, lime, magnesia, alumina, titania and a small quantity of iron oxide.

Aplite

A fine grained rock largely composed of plagioclase feldspar, divided between albite ($Na_2O{\cdot}Al_2O_3{\cdot}6\ SiO_2$) and anorthite ($CaO{\cdot}Al_2O_3{\cdot}2\ SiO_2$) in the ratio of approximately 60% and 40%, respectively. Secondary zoisite ($4CaO{\cdot}3Al_2O_3{\cdot}6\ SiO_2{\cdot}H_2O$) and muscovite ($K_2O{\cdot}3Al_2O_3{\cdot}6SiO_2{\cdot}2H_2O$) are associated with the basic minerals. The rock could more properly be called anorthosite or andesinite mineralogically, but the industry has widely accepted the name Aplite.

The material has a PCE of 8-9 and, in general, shares the attributes of other feldspars and nepheline syenite. Commercial production is centered in western Virginia. The grades used by the structural clay products industry are generally by-products available at low cost. Granular and fine-particle grades are sold.

Aplite is used as a molding sand in soft-mud brick, alone or in combination with other sands and coloring materials. Similarly used in stiff-mud brick in the rubbing box or by sand-blasting methods. Various desired colors are obtained in these ways. Typically gives pink effect when used alone on red brick.

The coloring principle is apparently optical, little or no fusion being experienced at typical production temperatures. The latter fact requires adherence additives, such as borax, in soft-mud brick.

In face brick and other structural products Aplite serves as a low-cost flux where operating temperatures are suitable to encourage eutectic formation. One producer supplies low-cost material in a variety of screen sizes permitting its use as a grog to control drying and shrinkage in low-temperature operations.

CLAY
Body Conditioners • Coloring Agents
Deflocculents • Binders • Fluxes
MODIFIERS

Barium Carbonate

$BaCO_3$. Insoluble in water but soluble in acids. Melts at 1,360°C. Poisonous. Occurs as the mineral witherite, which is mined in England and California. The precipitated barium carbonate used in ceramics is obtained from barytes which is reduced to soluble barium sulfide and converted to the carbonate by precipitation with soda ash.

Barium carbonate is used in glazes as a flux or to assist in the formation of a matt structure. Barium forms silicates slowly, but when barium is completely combined, it becomes almost as active a fluxing agent as lead oxide. When used in glazes in amounts greater than .1 equivalent, it renders the glaze too refractory for commercial firing.

It is used in large tonnages in the brick and sewer pipe plants to control dryer house scum and efflorescence. Dryer house scum develops when the water used in preparing the brick or pipe is evaporated in the dryer. Soluble salts, the most common of which are calcium sulfate and magnesium sulfate migrate to the exposed surfaces and are combined with the body to form complex insoluble white marks in the firing process.

Barium carbonate dosing precipitates the salts and the resulting compounds remain locked in the interior of the brick. The typical reactions are $BaCO_3 + MgSO_4 \rightarrow BaSO_4 + MgCO_3$. Other sulfates causing these difficulties are those of sodium and potassium. Brick containing free lime are subject to scumming in the kiln if sulphur bearing gases strike them when they are below the dew point of the kiln gases.

Barium carbonate can be added as a slurry or dry and should be used as early in the production line as is possible. The quantity of sulfate salts varies widely in the same pits and therefore the quantity of barium required will fluctuate widely. The most satisfactory way to determine amount needed is to make test brick from selected samples and maintain a record of barium required for material from each pit area.

Plants stockpiling raw material for later use can apply part or all of the barium requirement to stock piled material as it is laid down. In this connection it is worth noting that stockpiling can add to scumming difficulties if the clay contains appreciable amounts of pyrites, which can, under certain conditions, break down to form sulphuric acid which then combines to form soluble salts.

Each load of material dumped into the grinder can be treated with barium applied in batches or the barium can be added with a sensitive feeder continuously. It can be added to material drawn from storage while being conveyed to the pugger. Barium and water slurry can be added at the pug mill as all or part of the water added to develop plasticity.

Barytes

$BaSO_4$. A natural mineral found in Missouri, Georgia, Tennessee, California, Virginia and other states. It is the chief ore from which precipitated barium carbonate is manufactured, but may sometimes be used in the natural state. It has been demonstrated that this ore, which is reasonably pure and unadulterated, can be used as a batch constituent in glazes, although its use entails special handling problems and the batch must be fritted.

Bauxite

A non-plastic claylike material used in the production of aluminum metal and aluminum oxide for the ceramic field and the chemical industry. It is used by itself as an addition to abrasives, refractories, cements and other ceramics.

The amounts of silica, iron and water present in bauxites control the value for use in refractories, abrasives and in cements. For refractory purposes a calcined bauxite of high alumina content, controlled low iron and low loss on ignition is required. It is an excellent material for refractory brick, provided adequate attention is given to initial calcining to take care of the tendency of bauxite with residual moisture to shrink at the temperatures at which the refractories are used. Bauxite refractories have adequate strength when cold and at working temperatures. They resist cracking, spalling and chemical and physical reaction with the furnace charges with which they come into contact.

Mullite refractories are produced from mixtures of bauxite and silica sand or quartz by the sinter-bonded method or by the electrically fused-cast method, in which case the starting material is alumina derived from bauxite.

The chief uses of bauxite refractories are: For linings in rotary kilns for the manufacture of portland cement, dolomite and lime; for lining in combustion chambers of boiler installations for use in ceramic industries, e.g. glass tank blocks, furnace parts, regenerator wall construction and in checkers; in the metals industry for center walls of zinc distillation furnaces, bottoms of malleable iron furnaces, water cooled parts of basic open hearth furnaces and in all types of furnaces where the ash has a high corrosive effect on brick.

In recent years bauxite has been used in increasing quantities for the manufacture of special quick hardening high alumina cements. These cements are prepared in blast furnaces, rotary kilns or electric furnaces by the fusion of bauxite and limestone. The resulting product consists of a mixture of calcium aluminates and calcium aluminum silicates with some iron oxide and possibly some calcium silicates.

Bauxite abrasives are prepared by fusion of a mixture of calcined bauxite, coke and iron turnings in an arc type electric furnace at temperatures above 2,000°F. Massive corundum crystals containing 94-95% aluminum oxide result. These are crushed, ground and separated into various grit or grain sizes which are then manufactured into abrasive products such as grinding wheels, abrasive stones, abrasive cloths and papers and grinding and polishing powders. Fused alumina grinding wheels are made of the material and used extensively in the metals industries in grinding and polishing.

Bentonite

A natural clay-like substance. A hydrous silicate of alumina. Derived from volcanic ash, with the clay mineral, montmorillonite ($Al_2O_3{\cdot}4SiO_2{\cdot}9H_2O$) as the chief constituent. The name of bentonite originally applied only to a specific type that occurs in the Fort Benton formation in the Black Hills of Wyoming and South Dakota. Later all clays comprising chiefly montmorillonite and derived from volcanic ash were classed as bentonites. For practical purposes it is necessary to subdivide bentonite into two types: (1) Those that swell enormously when wetted, and (2) those that swell no more than other plastic clays. Type 2 is widely used as a clarifying clay, as a carrier and sticking agent for insecticides, and for improving plasticity and workability in ware where color is not important, such as sewer pipe.

From 1% to 3% of bentonite is used successfully in high temperature cements, mortars and various plastic refractories. Bentonite is also used in structural ware to insure sharp edges, high green, dry and fired strengths. As low as ¼% of bentonite prevents glazes from settling; high film strengths are obtained.

Beryl

$3BeO{\cdot}Al_2O_3{\cdot}6SiO_2$. It is the ore from which Beryllium oxide is recovered by treatment of the ore with sodium silico-fluoride at 850°C. The resulting sodium fluorberyllate is dissolved in boiling water, filtered and the oxide precipitated with caustic. At present it is the only commercial source and consequently of prime importance.

To one interested in colored glazes, beryl offers an unusual property, the ability to produce high-temperature chrome greens.

Beryllium Oxide

(BeO)Beryllia. Melting point 2510°C, Specific gravity 3.0. This material, with very high thermal conductivity, good heat stock resistance and a hardness of 9 on the Mohs scale has been used for the production of very high temperature melting crucibles.

Bodies can be formed from a mix of high temperature grog and about one third fine, low temperature calcined oxide. Wax is used as a lubricant in the mix and, after pressing on a high pressure press with polished dies, the wax is carefully driven off with moderate firing schedules and final firing of the body can be carried out as high as 3,600°F.

Beryllia crucibles are useful in the melting of pure metals as the low reactivity retards contamination while the high working temperatures and shock resistance ease techniques. The literature takes note of the health hazards with special reference to the unpredictable susceptibility of certain individuals to dusts or vapors of the metal and its compounds and for this reason precautions should be taken to prevent exposure.

Binders

A fairly large group of organic materials which can be used in processing all types of clay and non-clay bodies to affect the mixing, forming and drying characteristics. On firing, the binding material is oxidized and leaves the body without entering chemical combination with the materials of the body, although the physical make up of the fired body may be radically affected.

By proper selection of binders an operator can:

1. Increase water of plasticity.
2. Decrease water of plasticity.
3. Increase green strength.
4. Increase dry strength.
5. Increase fired strength.
6. Increase hardness in the green and dried state.
7. Change the rate and total absorption of fired ware.
8. Change shrinkage in the dryer and kiln.
9. Reduce power required for forming.
10. Reduce warping, chipping and cracking.

All of these effects tend to improve the recovery of first class material from the kiln. Those few plants enjoying a 100% recovery, of course, have little to gain unless greater drying and firing rates are desired, but as dryer and kiln losses rise the economic justification of binders becomes evident.

A number of materials are available which will affect the raw clay. A program of testing should be carried out to determine the most economic with any particular clay. Different clays react quite differently with the same treatment and what proves to be best in one instance is not apt to be so in the next.

A preliminary study indicates that the following materials should be considered in any binder study.

1. Natural gums
2. Alginates
3. Waxes
4. Alcohols
6. Celluloses
7. Lignins

Gums, because of their relative high cost, are seldom used in structural units; however the gum group, which includes arabic, tragacanth, ghetti, locust seed and karaya have been used for many years as binder to improve adherence of glazes and engobes to green and dried ware and in such application should be considered.

Another high cost group of binders are the alginates. These materials are hydrophilic colloids derived from sea weed such as kelp from the Pacific coast. For the most part these binders replace the natural gums in glazes and engobes. Small additions have pronounced effects.

Waxes are derived from both vegetable and mineral sources. Used in the form of emulsions the waxes may be used singly or in blends. The effect

CLAY MODIFIERS

Body Conditioners • Coloring Agents Deflocculents • Binders • Fluxes

is twofold: in addition to serving as a binder they act as a good lubricant to bodies of little plasticity. In dust pressing, close size tolerances can be maintained, dry press operations can be carried out under higher pressures without pressure cracking and in stiff mud extrusion, laminations are reduced. Waxes have been specially developed for use in glazes and engobes to improve rub resistance.

Flours and starches are prepared from vegetable sources; potato, wheat and rice have been used but corn starch and corn starch derivatives are popular because of cost and ready availability as well as the wide range of corn products offered.

Dextrines are sugars converted from starch by acid treatments and are used in specific applications in the same way as starch.

In extruded materials, various dextrines and Corn Products' Hydracar brand binder are used to obtain added strength while green and during the first stages of drying. Globe brand dextrine, which can be used in this application, requires one to three pounds per ton of clay. It is a powder and highly soluble in water. Hydracar and dextrines are used in the refractory field, but here the plasticizing effect of the material is more important than the added strength.

Some corn cereal binders are used to reduce loss in the production of sewer pipe. A product used in this application is Mogul cereal binder, a pregelatinized corn starch product containing 5-7% corn protein. It is powder in form. Approximately ¼ of 1% is used to obtain maximum green strength.

The same material is also used in the production of face brick to cut losses. An addition of 1% can cut breakage 100% and only ½ of 1% will reduce such breakage significantly.

Polyvinyl alcohol is a white, water soluble powder which possesses excellent adhesive and binding characteristics. Films cast from aqueous solutons of polyvinyl alcohol have extremely high tensile strength and are impervious to oils and greases. By varying the conditions during manufacture, it is possible to produce a series of polyvinyl alcohols differing markedly in physical properties. The principal factors governing these properties are the degrees of polymerization and hydrolysis.

With each viscosity or polymerization range, several grades of polyvinyl alcohol are produced by varying the degrees of hydrolysis of the polyvinyl acetate. Of those hydrolyzed, about 99% or greater are generally referred to as "completely hydrolyzed," while those hydrolyzed to a lesser extent are referred to as "partially hydrolyzed" grades.

The two grades of Du Pont's polyvinyl alcohol generally used as binders for clay are "Elvanol" 72-60 and "Elvanol" 71-30. Where economic limitations are severe it can be combined with starch to reduce costs. For initial trials, one part of PVA to nine parts of a low viscosity, oxidized starch is suggested. Even in smaller proportion, "Elvanol," mixed with starch, will produce a noticeable improvement in binding characteristics over starch alone.

Methylcellulose, a synthetic gum, is an effective binder for refractories, structural clay products and abrasives. In addition, it functions as a lubricant, wetting agent and plasticizer. As a film former it toughens unfired glazes and improves bonding.

It has been used as a body addition and is highly regarded as a component of refractory mortars were its water retaining properties increase workability.

Both Du Pont's CMC and Dow's Methocel are produced in a range of qualities and viscosities with different effects. For this reason, product literature should be studied to insure economical results.

A large number of wood extracts are offered and because of their low cost, are logical products for consideration by structural producers who have production of large tonnages.

These products are available as liquids and powders, both relatively refined and unrefined and exhibit a rather wide range of properties.

Some are calcium based, some are sodium based and with different clays results may be expected to vary. The degree of sulfonation is also subject to control.

Lignins should be added, as all binders, with accurate feeders as the actual addition is very small and variations in the rate will produce problems greater than the original ones.

Lignins are by-products of the paper industry and have been used in the structural clay industry for many years. A sewer pipe manufacturer reports elimination of a high cost plastic clay, added at a 30% rate, when a ½% addition of "Goulac" a Rabeson Process Co. product was used and several face brick manufacturers have indicated a 50% reduction in pugging water while using Kimberly-Clark's "Additive A."

Mixtures of binders from the different classes sometimes are much more effective than when either is used alone. A laboratory testing program should be undertaken by producers interested in binders with the idea of determining most promising binders for plant scale trials.

Body Stains

They are combinations of various oxides calcined together at high temperatures. The most common system is composed of oxides of chromium, antimony, and titanium, which yields a wide variety of yellow, tan, and brown shades. A uniform color through the body is produced by mixing the body stain with the raw material before forming. Cobalt aluminates or silicates are used for blues, manganese alumina calcines for pinks and chrome based stains for greens.

Borax

$Na_2O{:}2B_2O_3{:}10\ H_2O$. Practically all American Borax comes from California. The mineral tincal is mined in the Mojave Desert and is processed and marketed as Borax. Borax is also prepared by the evaporation and purification of brines from Searles Lake. It is soluble in water and soluble in acids and melts in its own water of crystallization. It has a mol. wt. of 381.43, sp. gr. of about 1.72 and a hardness of 2.0-2.5.

The water of crystallization is eliminated during fusion with other ceramic raw materials, leaving 52.8% by weight of sodium and boric oxides to form part of the ceramic composition. The purity of ordinary commercial borax is guaranteed over 99.5%, the original impurity being largely clay. It is obtainable in large crystals, powdered, and granular form. The last being regarded as the most practical and economical for ceramic use.

Anhydrous or fused borax, $Na_2O : 2B_2O_3$, melts at 736°C and is soluble in water, its rate of solubility being considerably slower than borax at 20°C but about the same at 60°C. Theoretically it contains no water of crystallization, and actual analyses show less than 0.5% water. Anhydrous borax may be substituted for ordinary borax, approximately 53 lbs. being equivalent to 100 lbs. of the hydrated material. Unlike borax, it does not puff or swell to a light fluffy mass during the melting operation, and therefore its use minimizes segregation and loss, particularly in furnaces operated under strong drafts.

Borax is widely used as a flux for glazes on ceramic bodies. The boric oxide shares with silica the property of combining with bases to form glassy compounds after fusion. The readiness with which boric oxide combines with bases finds application in the production of pottery colors from metallic oxides; the shades obtained often vary according to the percentage of boric oxide used. It also has an important function in reducing the viscosity of glazes; by the addition of a little borax, the most viscous glazes are made to heal better. Borax also tends to produce higher gloss in a glaze and lowers the maturing temperature.

Borax is used mixed with salt in vapor glazing of sewer pipe and structurals. In most cases the optimum amount of borax is 10% and the balance salt. The mixture is applied in the same manner that salt alone is used in salt glazing. The major result is a reduction of crazing and pinholing with a significant increase in glaze thickness. (See anhydrous rasorite.)

Boric Acid

$½(B_2O_3{:}3H_2O)$. Boric acid is produced by treatment of borax with sulfuric acid and occurs, in limited quantities, as the mineral sasolite in Italy. It is not as economical a source of boric oxide as borax. It can be used where the addition of sodium must be limited.

Calcined Clay

Any clay when heated to a low red heat loses many of its claylike properties; the ability to form a plastic mass is probably the most important followed by the permanent reduction in size. Strictly speaking, grog, made by grinding cull fired clay bodies and calcined clay are identical but their physical condition may vary within wide limits.

Calcined clay can be prepared by passing through a rotary kiln or by any of a number of batch methods. Power to form a plastic mass is lost around 1,200°F but the ultimate shrinkage is not reached until the material is heated to much higher temperatures. This ultimate temperature will vary with different clays and its necessity will depend on the use to be made of the resulting material.

The addition of calcined clay to highly plastic clays will reduce the plasticity of the mixture to any desired point. In the production of structural products it will increase the production rates from grinding, tempering and extrusion operations. By reducing shrinkage in the dryer and the kiln, serious production bottlenecks can be overcome with an important increase in quality.

An important percentage of refractories contain calcined clay usually in the form of grog. (See Grog.)

Calcium Carbonate. (See Lime)

Calcium Fluoride. (See fluorspar)

Calcium Aluminate

A pure hydraulically setting calcium aluminate cement is available for applications requiring high refractoriness. This material is made from Bayer process alumina and high-grade lime and contains less than 2% total impurities. It contains 80% Al_2O_3 and 18% CaO. A typical chemical analysis is as follows:

CaO	18%
Al_2O_3	80%
Fe_2O_3	0.4%
SiO_2	0.1%
Na_2O	0.5%
MgO	0.4%
S	0.06
Ignition Loss	1.0

PCE — 34 (3205°F.)

This cement can be used with conventional fire clay grogs as well as super refractory grogs such as Tabular Alumina. The hydraulic compounds formed in setting are $CaO \cdot Al_2O_3$ and $CaO \cdot 2Al_2O_3$. These have high bonding strength at room temperature and above. At 2000°F the hydraulic bond is destroyed but ceramic bonding then takes place and high strength continues up to the softening point, 3200°F.

Pure calcium aluminate cement has appreciably higher strength than impure calcium aluminate made from bauxite in the critical temperature range, 1500 to 2000°F., where the hydraulic bond is lost and the ceramic bond is not yet formed. In fact pure calcium aluminate cement with a grog of Tabular Alumina, 15% cement and 85% Tabular Alumina (Cal Tab 15) has even higher strength at 2000°F than at room temperature, as shown in the following data:

Cal Tab 15	Modulus of Rupture (psi.)
As cast, 24-hour cure	650
Fired 5 hours at 2000°F.	1200

Calcium Oxide. (See Lime)

Calcium Sulfate. (See Plaster of Paris)

Carbon

A growing number of refractory brick are being produced that contain elemental carbon as the refractory material. Coke ground and graded is a popular source of the material, which is held together with tar. These brick are used in the metal producing industries in places where they are protected from exposure to oxygen. Used with reason, carbon brick are reported to offer outstanding advantages of high refractoriness, low and uniform expansion under heat, and high thermal shock resistance.

In addition to coke they can be made of charcoal, anthracite, petroleum coke or graphite. Tar binder is mixed with the carbon and pressed with mechanical presses, dried in unheated rooms and fired in kilns from which all oxygen is excluded from the setting.

Clays

Clays are chiefly made up of hydrated aluminum silicates. The most common of these is the kaolinite group (Al_2O_3 $2SiO_2$: $2H_2O$) and the montmorillonite group (Mg. Ca)O : Al_2O_3 : $5SiO_2$: nH_2O.

There are two types of clays, the residual and secondary. The residual occurs in the place where it was developed by weathering. Secondary clays are transported from the original site by water or other means as ice and deposited in a remote area.

The pure kaolinite and montmorillonite clays are made of very minute plate-like structures, and these plates are responsible for the plasticity of the clay when mixed with water.

The normal behaviors of clays in the ceramic process is to develop plasticity, have a formability, have a rigid state and fire to a stone-like hardness, developing various colors.

The exceedingly high content of fine particles is characteristic of very plastic clays, and has a direct relationship to their working properties. The finest portion contains the clay suspensoids or colloids which are responsible for the plasticity. The greater part of this fine material consists of granular material while the colloids are really only a very small amount. A high content of the so-called clay substances is sometimes accompanied by an excessive degree of plasticity which renders a clay sticky and difficult to work. Other very important factors in plasticity are the amount, size, relative proportion of sizes, shape and character of the granular material, and the amount and character of the soluble salts, i.e., electrolytes present.

The influence of the fineness of grain of a clay is not limited solely to its relation to plasticity, but extends to other properties, namely, drying conduct, drying shrinkage, warping, tensile or transverse strength and bonding strength.

It may be said that the greater the proportion of the fine material, the slower the rate of drying, the greater the shrinkage and the greater the tendency to warping and cracking during this stage. It is the usual practice to mix these clays with coarser materials which overcome these difficulties.

If we compare two clays of different degrees of plasticity, we find that the more plastic requires more water to make it workable and that the loss of water in the drying operation takes place more gradually because of the very extensive capillary system. Also we find that there is a greater shrinkage in the highly plastic clay.

Clay, Ball

Ball clays are aluminum silicates found chiefly in Kentucky and Tennessee. They are very plastic sedimentary clays which are fairly refractory, maturing from Cone 18 to Cone 34. It will burn to a rather near white color. Some ball clays will vitrify as low as Cone 8 and 10.

The refractories industry is a large user of ball clays, particularly in the ramming mixes, castables and plastic refractories. Since all of these must be put in place and remain rather hard before being matured in clay, such as ball clay, which has high plasticity and high dry strength, is used to develop the strength of this refractory in dry state. Ball clays are very workable into shapes and holds its shape after once formed.

Special refractories which require a great amount of prefired grog material need some plastic clay to hold the shape of a brick or a special shape. This plastic is ball clay. In some cases, as little as 10 or 15% ball clay is used to suspend 85 to 90% of grog.

Some ball clays are used in engobes to decorate brick and tile. Since ball clays are quite plastic, they are moderated with flint and color to match body shrinkages of brick and tile and make a good coating surface in any color.

Ball clays are used normally in the heavy clay products industry for their plasticity in the working stage, and for dry strength in the dry stage. In some instances, in colored brick surface.

Chromium Oxide

Cr_2O_3. Mol. wt. 152, sp. gr. 5. A bright green crystalline powder insoluble in acids and alkalies.

Chromium is used mainly to impart a green color. It is most often introduced as a chromium oxide or potassium dichromate, but the dichromates of sodium and ammonium and the chromates of potassium, sodium and iron find occasional use.

In glazes, chromium oxide, or other chromium compounds, are commonly used to produce green colors. The oxide itself is generally used in raw glazes while potassium dichromate is more common in fritted glazes. An oxidizing fire must be provided to avoid development of a black color.

In such glazes, zinc oxide will produce a brown color, due to the formation of zinc chromate, and high lead glazes will form the yellow lead chromate. Tin oxide, of course, cannot be present, as it will form the chrome-tin pink.

Coal

This is an amorphous form of carbon and has its origin in vegetable matter which has become decomposed by chemical activity and often pressure. Widely used as a fuel in the structural and refractory industry, it has been replaced by gas or oil in many plants.

It is used as a grog-like material in some plants to expedite forming of brick. In this use it acts to reduce lamination due to the keying action of the coal particles promoting greater production and better quality. Due to the sulphur content, it can add to the scumming problems of a producer.

All of the heat value is recovered from the coal which can be added in the pug mill or can be ground with the clay in the grinders. Some clays are naturally rich in carbonaceous material, similar to coal, and furnish much of the heat required to raise the body to the maturing temperature. An additional effect of the coal is the reduction of the unit weight of the ware.

Coal also serves as the raw material for the production of coke, which can be used in brick similarly and which is also used in the production of light weight aggregate and as a raw material for the manufacture of carbon refractory brick.

Anthracite coal can be used for the fuel in lightweight aggregate production; in this use, the ash becomes part of the product.

Cobalt Oxide

Co_2O_3 : CoO. Mol. wt. 240.8 and sp. gr. 6. Insoluble in water and most mineral acids, but soluble in sulfuric acid. This black powder is obtained by roasting cobalt ore from Northern Rhodesia, Morocco, Burma and Canada in order to drive off arsenic and sulfur, and then, by separating the residue from the nickel and other constituents. Cobalt oxide is used as a coloring medium in ceramic ware and glazes.

Stains can be used in connection with glazes, which are compounded from alumina as a base, with lighter blues than the usual cobalt are obtained. In the case of high cobalt content, there is a slight tendency toward a greenish tint when low fire is given. In proper combination with MgO, SiO_2, and B_2O_3, a beautiful red, violet, lavender or pink color can be obtained. Cobalt in combination with manganese is also used in the production of black spots on terra cotta glazes.

Cobalt Sulfate

This material can be used to impart a blue or blue-white color to white bodies. The sulfate is dissolved, added to the body and then precipitated with sodium carbonate. The effect of as small an amount as one pound of cobalt sulfate on one ton of clay will be noticeable.

Colemanite

A natural hydrated calcium borate, 2 CaO : $3B_2O_3$: $5H_2O$. It occurs in California and Nevada and was formerly the chief domestic source of borax and boric acid.

Colemanite can be used very satisfactorily in many raw lead glazes where the addition of CaO and B_2O_3 is desired without using a frit. It is especially useful in the development of some pink and maroon red glazes, both matt and bright, at temperatures from Cone 01 to Cone 07. It has been found that this material can be used in place of high whiting content and that it will bring out better shades of pinks and maroon in commercially prepared stains.

Copper Oxide

Two materials, Cupric oxide, CuO, or Cuprous oxide, Cu_2O, are used as a source for copper oxide. Cupric, insoluble in water is derived by the ignition of copper carbonate or copper nitrate, copper hydrate, or oxidation of lower oxides. Cuprous is prepared by the oxidation of copper, by the addition of bases to cuprous chloride, or by the action of glucose on cupric hydroxide or upon copper scale.

Cupric oxide, when used in glazes, has a wide range of color. It may be used either as the raw oxide in a raw glaze, as the raw oxide in a fritted glaze, or as a part of the frit itself. It is used equally well in any of these cases, but, when mixed with the frit, there is a loss of color strength under certain conditions due to volatilization of the oxide, and it is not so satisfactory above Cone 4 when operations are carried out under oxidizing conditions.

Copper oxide is the only individual pigmentary oxide in common use which in practically every combination and under ordinary conditions produces clear green colors. In combination with tin oxide and other opacifying agents, it gives turquoise or blue-greens when the glaze is alkaline.

The amount of copper oxide in the glaze for light shade of green will be 0.03 to 0.06 equivalents, and for darker shades from 0.06 to 0.10 equivalents. The variable amount will depend almost entirely upon the composition of the RO group. In glazes containing PbO in fairly large amounts, smaller than normal amounts of copper oxide are used.

Copper Carbonate

$CuCO_3$: $Cu(OH)_2$. It is derived from the interaction of sodium carbonate and copper sulfate.

Copper

Copper carbonate is used to introduce copper colors into glazes, especially in cases where, instead of getting the blues and greens of copper oxide, it is desirable to get the lavenders, reds and purples obtainable under reducing conditions. A brilliant red glaze is produced with 0.2-1% copper carbonate, 1% tin oxide and a reducing agent of 0.2% silicon carbide.

If, in the same glaze, the silicon carbide is omitted and the stannic oxide increased to 5-7%, a blue results, thus allowing the development of copper reds and blues or greens on the same piece.

Cordierite

Cordierite is a magnesium aluminum silicate with the following formula: ($2MgO$: $2Al_2O_3$: $5SiO_2$). Its specific gravity is rather high, ranging from 2.6 to 2.7 and it is the hardness of colindite ranging from 7.0 to 7.5 on the Mohs scale.

Although cordierite is found over the world, it is chiefly developed in clay bodies by adding talc to a rather pure clay.

Cordierite, which is theoretically 39.6% talc, 47.0% clay and 13.4% alumina, has an extremely low coefficient of expansion. It can be heated up very rapidly and cooled down very rapidly. Repeated heatings and coolings do not affect it.

By itself, this composition has a very short vitrification range and must be fired very carefully. In fact, it cannot be fired too successfully in commercial kilns. Zirconium silicate is used as a modifier for this body, giving it a better firing range so that it can be fully developed in a commercial kiln.

Cordierite type compositions have been used for insulation in high temperature operating mechanisms as meters, radar, and so forth. Its use in general run of refractories is yet to be developed to a high degree.

Crocus Martis

An oxide of iron used mostly in the preparations of underglaze colors and sometimes in glazes as a coloring agent. It develops, when burned in an oxidizing flame together with other glaze constituents, a reddish-brown color.

CLAY MODIFIERS

Body Conditioners • Coloring Agents Deflocculents • Binders • Fluxes

Cryolite

A mineral, sodium fluoaluminate, having chemical composition Na_3AlF_6. The refined material is sold under the trade name Kryolith and is available as a minus 80 mesh powder in 100-lb. bags.

Cryolite can be used in clay products as an auxiliary flux. Its Fluorine content aids in dissolving silicates. As a mineralizer, Cryolite promotes Mullite formation. Cryolite is also a powerful flux and opacifier in glazes for special purpose bricks.

Used as a mineralizer or flux, Cryolite promotes denser structures and lowers maturing temperatures in clay tiles and bricks.

Cullet

Broken or powdered glass. Can be used in refractories to form an intermediate ceramic bond between where organic binders burn out and before high temperature binders begin to develop ceramic bonds.

Can be used in engobes or "sands" applied as facing treatments to brick and in this use the relatively low melting points serve to bind the coating to the body.

Deflocculant

Any substance which when added to a mixture of clays and water, will cause the mass to become more fluid is called a deflocculating agent. Or, more simply, deflocculant.

Deflocculants may consist of hydroxides of monovalent cations (such as $Na+$, $K+$, or NH_4+) or salts of these cations that hydrolyze to a base (Na_2CO_3 or sodium silicate). Or they may be organic colloids such as pyrogallic acid, tannic acid, humic acid or alkali salts of these materials.

Certain clays contain varying amounts and variable sorts of organic matter which can react with soda ash or caustic soda to form highly effective deflocculants. Variation in slip quality is often traceable to differences in the quantity of organic deflocculant produced from batch to batch, either because of organic variation or processing differences.

Colloidal silica is a potent "protective colloid" and for this reason the higher SiO_2 sodium silicates are more effective as deflocculants for a given Na_2O content than those lower in SiO_2.

Some nonionic colloids, notably gums and glues, can be used to disperse clays in presence of water. Starch is an especially effective deflocculant.

The sodium salts of the polyphosphate glasses are extremely efficient deflocculants and constitute a special case because they can produce very fluid slips at relatively low pH (under 5.0) and high solids (upwards of 70%).

Since deflocculants liquefy, several advantages are evident. Less water is needed to produce a given plasticity and flow. Less horse power is needed to extrude the clay. The body is denser as a result of less water content.

The deflocculant may be a flux and lower the maturing temperature of the clay.

Sodium silicate is a very important deflocculant in plastic refractories because it can develop plasticity without the addition of too much water. Also, sodium silicate dries very hard and assists the ball clay in developing the hardness necessary for plastic refractories, ramming mixes and castables. It probably is one of the chief ingredients in this flexible type of refractory.

Sodium silicate has been used in many instances in stiff mud extruding. Besides wringing out the good properties of a deflocculant, sodium silicate also has a certain binder quality which aids in making good clay products.

The use of sodium silicate with the make-up water and dry press mixes assists in binding the dry press body, besides increasing flowability in the die and good packing.

Dextrin

Used as a binder and plasticizer for clay products, dextrin is derived from starch by treating with acid while being heated. (See starch and binders.)

Diatomaceous Earth

Diatomaceous silica, diatomite, Kieselguhr, is a highly siliceous mineral derived from skeletons of microscopic organisms. It is mined extensively in California. The desirable characteristics of the material are its closed cells and high porosity which give a low density and a low thermal conductivity. Fusion point is 1715°C. Density is .8 to 1.2. Occurrence is widespread.

Insulating brick are made of this material by three methods. One type of brick is cut directly from the deposit and used in temperatures up to 1,500°F without shrinking. Where high temperatures are experienced, the brick cut from the deposit are pressed from the dust and prefired from 1,800 to 1,950°F to shrink them. Fired over 1,950 the brick develops spalling tendencies. To avoid the objectionable cristobalite form of SiO_2, which causes spalling, the brick is fired to 2,500°. To this brick is added 1 to 3% lime as a catalytic agent, and the brick is called tridymite brick. Grog, spar and clay are also included in the formula.

Dolomite

$CaMg(CO_3)_2$. Dolomite is a rock intermediate in composition between limestone and magnesite. It has a specific gravity of 2.9 and hardness of 3.5-4.0. The true material is composed of 56% calcium carbonate and 44% magnesium carbonate. There are, however, other materials containing appreciable amounts of magnesium carbonate, but less than the 44% present in pure dolomite, these are commonly called limestones and are used in the ceramic industry.

In the raw state, dolomite may be light buff, pink, yellow to brown and gray to blue. Its physical structure may be either crystalline or amorphous. When fired, dolomite is white; it decomposes to magnesia and calcium carbonate at 1,350-1,450°F. At about 1,650°F, all CO_2 is expelled, and the material burns to dolomite lime (CaO : MgO). In the presence of lower melting fluxes of acid character, it frequently decomposes at still lower temperatures.

Commercial deposits of dolomite are well scattered with important ones being located in Ohio, New York, Connecticut, California, Pennsylvania, Missouri, Texas and Kansas.

In general, dolomite may be substituted for nearly any other type of lime flux in glazes when other batch constituents are properly compensated. In ceramic bodies it promotes a glassy bond reacting with feldspar, flint and clay in the range of Cone 1 to 12 to form a lime glass. This property is of particular value in promoting the maturing speed, especially under rapid firing schedules.

The amount to be used varies with the vitrification desired and the firing temperatures, but the range of ½ to 8%, based on dry body weight, covers most vitreous and semivitreous bodies. Frequently a reduction in feldspar, with compensating increase in flint, seems to be possible. When dolomite is used to replace whiting, the safe firing range is widened by 1 or 2 cones. In combination with other fluxes, dolomite is effective as low as Cone 03-04 and is in use as an auxiliary in those clays which carry variable amounts of alkaline earths. In such bodies, it acts as a stabilizing flux and tends to widen as well as lower the firing range.

Electrolyte

For ceramic applications, an electrolyte is an acidic, basic or neutral substance capable of dissociating partly or completely into ions in water solution. The basic electrolytes promote deflocculation whereas the acidic and neutral compounds usually bring about flocculation of clay-water dispersions.

Thus the type and amount of electrolyte can be used to govern the character of ceramic slips and bodies and thus influence plasticity, casting qualities, dry properties such as strength and fire properties. Examples of basic electrolytes are caustic soda, soda ash and sodium silicate. Acidic electrolytes may be acids such as HCl or acid salts such as NH_4Cl. The neutral electrolytes are salts of strong acids and strong bases such as NaCl. (See Deflocculants.)

Engobe

An engobe is a clay or mixture of clays, fluxes and nonplastics which can be applied to a clay body such as a brick or tile which can be tinted any color and will cover small defects on the face of the body. Engobe can be used between the clay body and a glaze surface to mask the natural color of the body.

However, in structurals, engobes are of interest when used to color the ware and to change the appearance or texture of the unit. Many common clays can be used in the preparation of engobes in which case they should be finely ground or, if easily slacked, mixed with water and blended. All particles not passing an 80 mesh screen should be reground or discarded. To this base material, feldspar, calcium carbonate and flint are commonly added to affect shrinkage, softening point and refractoriness of the engobe.

If local clays are not available that have compatible colors, which usually means light firing shades of buff or white, commercial ball and china (kaolin) clays can be used for the base material. Due to the comparative high purity of these clays, preparation is simplified but they might not be as easy to "fit" to the body as local clay.

Engobes are sintered or vitrified to a greater or lesser degree and differ from glazes in that the glassy phase is not strongly developed. Other modifiers that can be used are magnesium carbonate, barium carbonate, bone ash, zinc oxide, mica and lead oxide.

Engobes can be applied in a number of ways to bodies in the green or dried condition or even to a prefired body if that should for some reason be desired. Engobes may be applied by dipping, rolling, brushing or spraying.

Any of the common coloring oxides can be used to affect the fired color of the engobe, or local occurring materials can be used. Colors that do not contrast with the body color are preferred as small chips and imperfections are not as critical. The pallet of colors is practically unlimited, however.

Engobes do not stick badly in the kiln if properly formulated. Coarse sand can be mixed with them for fine architectural effects. They can be applied over practically any texture.

Epsom Salts. (See Magnesium Sulfate)

Feldspar

Feldspar is the most common mineral in the crystalline rocks. The feldspars form a group of which the principal types are orthoclase, microcline, albite and anorthite. These are aluminum silicates of potassium, sodium and calcium. Chief commercial sources of supply are North Carolina, South Dakota, Colorado, Maine, Virginia, Arizona and Connecticut.

Free quartz acts as a dilutent in feldspar and decreases the fluxing power. In unburned ceramic bodies, feldspar acts as an anti-plastic the same as sand does. Soda feldspar and quartz mixtures deform much more rapidly after deformation begins than do the potash feldspars or any of their mixture with quartz. High soda content, in general, indicates low deformation or low fusion temperature. The fusion point of a feldspar depends upon the alkalis present and becomes lower as the soda content increases and the potassium oxide content decreases. Some spars fuse as low as cone 4; others as high as cone 10 but the general average fuse at cone 8 to 9.

Feldspar is frequently said to be a universal flux used in all types of ceramic bodies.

Feldspar is widely used in glazes for structural clay products including facing tile, ceramic sewer

pipe glazes, terra cotta, etc. Its role in glazes is to provide fluxing action and it should be finely ground for this purpose. Generally a material that is ground to at least 98% finer than 200 Mesh is purchased and this, of course, is subjected to additional grinding with other glaze ingredients in ball mills prior to use. Both potash and soda feldspars are used in glazes but preference in most instances is for a potash type. Potash spar is desirable because it dissolves the silica more readily and makes a more durable glaze. Soda feldspar has an advantage of making a smoother fired glaze.

In recent years specialty face brick and tile in a wide range of pastel colors and white and black have been produced commercially using potash feldspar as a major ingredient in the ware itself. In this application the finely ground feldspar from Custer, South Dakota, acts as a major flux which allows earlier maturing of the clay body. A secondary role is to act as an extender for the expensive mineral oxides used as coloring agents in these brick.

Several face brick manufacturers have developed "sand coatings" or "granular coatings" for red burning brick. These coatings impart attractive color and texture to red burning ware. Feldspar is a major ingredient in many of them. It acts as an extender for the expensive coloring oxides. However, its major function is as a flux to form a fired bond between the coating and the brick itself. Soda feldspar is preferred due to its lower fusability.

Fine ground feldspar rejects have been used in some buff and red burning face brick to provide greater vitrification and lower fired absorption at lower temperatures. In experimental work done at Clemson College, additions of low cost feldspathic brick flux in amounts from 2.5 to 10% resulted in equivalent porosity for the brick with the additive from three to five cones lower. Additions of from 5 to 10% of brick flux prepared from feldspathic waste material improved the fired modulus of rupture of the structural clay product body by 10 to 25%.

The work of Clemson College by the Dept. of Ceramic Engineering showed that the fineness of the flux which is added is at least as important as the chemical composition. In the case of the feldspars studied at Clemson, 200 Mesh feldspar from Kona, North Carolina, and 200 Mesh feldspar from Bedford, Virginia, gave more outstanding results than did coarser grinds of the same materials.

Flint

SiO_2. A black, gray, or brown cryptocrystalline variety of quartz. It commonly occurs as nodules, either with calcareous coating in clay or as coarse pebbles along a seashore where the coatings have been removed by attrition. The dark color of flint is probably due to carbonaceous matter. The mineral breaks with a characteristic conchoidal fracture, is readily soluble in alkaline solution at 200°C, and is soluble in fused feldspar. Flint pebbles are quarried along the coasts of Denmark, France, and England. It should be clearly understood that in the United States ceramists often employ the term flint to include other siliceous minerals in addition to true flint; "sand flint," "rock flint," tripoli flint," generally called potter's flint, are various types of ground sandstone and quartzite, not true flint, but utilized in exactly the same way.

Fluorspar

Fluorspar is a name most accurately applied to nonmetallic mineral aggregates which contain a large amount of calcium fluoride, CaF_2. Calcium fluoride, in fluorspar, constitutes the mineral, fluorite, containing almost equal percentages by weight of the elements, calcium and fluorine. The mineral fluorite is a glasslike substance, translucent to transparent, even opaque at times, and ranging in color from colorless to bluish through varying shades of violet, purple, green, and yellow.

As found naturally, it is crystallized into well-formed cubical shapes and it cleaves readily into octahedra. Mined as fluorspar, it is commonly associated with many different accessory minerals and must be processed by various types of beneficiation techniques. Most commercial domestic fluorspar is mined in Kentucky and Illinois.

Fluorspar has a long history of utilization as an active fluxing agent in ceramic wares, especially in glasses and enamels, as well as in glazes and porcelain bodies. These uses demand a higher purity fluorspar containing upwards of 90% of the mineral, fluorite. When used as an additive to heavy clay products, the purity is secondary in importance to the fineness of the fluorspar.

In its most common use as an additive to light firing brick, tile, etc., Ceramic No. 2 grade fluorspar is of sufficient purity. A very fine-grained fluorspar, essentially finer than 325 mesh, is marketed under the name "Superfine." Also available is a fluorspar treated to improve its wetting properties. The properties of fineness and wettability of this additive are desirable because, unlike some efflorescence deterrents, fluorspar is quite insoluble. Again, for this reason, the fluorspar should be added early in the clay preparation technique to insure intimacy of mixing with the clay. The admixture is best done in the secondary grinding stage, for example, at the dry pan.

Incomplete mixing will result in local concentration of this strong flux within the ware giving rise to heterogeneous maturation upon firing. Local aggregation of the flux can cause spalling of the ware due to differential maturity within a single unit.

Fluorspar has been found to be the most economical, most effective, and most easily usable additive for the prevention of green efflorescence in light firing ware. Its effect is twofold. Through its fluxing action, it promotes earlier vitrification and consequent lower porosity in firing, thus reducing subsequent movement of soluble vanadium salts to the surface of the ware.

Secondly, through reaction with compounds of vanadium, insoluble compounds are produced, or, in some instances, volatile phases result which are driven off during firing. In each of these events, the result is the successful prevention of green colored efflorescences.

The amount of the additive necessary can only be determined through trial testing. On the average, about 2 per cent by weight is normally sufficient for control.

In addition to its ability to curb green efflorescence, fluorspar has been noted: to reduce white efflorescence due to soluble sulfates; to deter colored efflorescences due to molybdenum; and to prevent brown staining caused by manganese compounds. In all instances of its use as an additive, even firing, through good temperature control techniques, is essential to prevent over-firing or undesired deeper colors of light wares.

Flux

A flux in ceramics as well as other compounds is a material which lowers the fusion point of any mixture in which it is present.

For instance in certain castable plastic and ramming refractories, glass is used as a flux to melt the particles of clay together at a low temperature and form a hydrofractory in place earlier.

Certain materials as feldspar, volcanic ash, nepheline syenite will act as a flux on high temperature firing clays to lower their temperatures of maturing in the manufacture of brick and tile.

Certainly fluxes are very important in developing glazes on brick and tile. Lead is generally the chief one of these fluxes. Lead silicate, a commercially prepared combination of lead and silica, is used for fluxing glazed materials. Boric acid, borax, soda ash are some of the other materials used for fluxing glazes.

Frit

A glassy material produced by fusing a mixture of some or all of the constituents of a glaze or enamel so as to render insoluble any soluble materials present, and also to insure greater homogeneity, to lower the melting point, and to render toxic compounds non-poisonous.

To qualify as frit, the glassy material must be in a granular form, for the word derives from "Fritting," the process of quenching molten glass.

In glaze work it is often necessary to use low-fire leadless glazes, and here the frit plays an important part. In most low-fired glazes, soluble materials are necessarily used, and fritting renders them insoluble. A fritted glaze of the low temperature type is said to be more stable than a low temperature raw glaze.

Glazes

Generally homogeneous, thin silicate mixtures fused on the surface of a clay body. They are glasses in their physical and chemical nature, hard, slightly or completely insoluble excepting in strong acids or bases, impermeable to gases and liquids. Like glasses they are not definite chemical compounds but complex mixtures which sometimes are described as undercooled solutions since many of their properties are analogous to those observed in ordinary solutions.

Glazes are more or less lustrous. Generally the surface is highly reflective or glossy, but the matt glaze has a surface which has been compared, quite accurately, with the appearance of a glace kid, and all gradations of glossiness or mattness may be observed.

Glazes may be colored or colorless, transparent, translucent, or opaque. Whatever the appearance, the glaze or similar coating is used on claywares to make the ware impermeable to liquids and gases and/or to provide a decorative effect. Designing of glazes to "fit" any given body is a complex problem involving variables of temperature maturity, expansion under temperature, viscosity, toxicity and color.

Glaze Stain

Glaze stains are prepared calcined ceramic pigments, to be mixed with a glaze before it is applied to the body to give a uniform color throughout the glaze layer. Most glaze stains function as pigments. Some remain as precipitates, others going in solution in the fired glass. The color range of glaze stains is very wide at the lower temperatures but at Cone 8 or hgher many glaze stains became unstable to some degree and the obtainable color range is much more restricted.

Glue

An impure form of gelatine which can be used as a binder both for glazes and for bodies. (See Binders.)

Grog

Generally any clay-like material that has been fired to a temperature where the characteristic plasticity is destroyed. Used in structural production it serves to eliminate laminations, makes drying and firing faster and with less shrinkage.

It is much used in refractories, terra cotta and sewer pipe. While strictly speaking grog includes calcined clay, generally the latter is excluded from the classification. Grog can be made from cull material or pieces especially made and fired for this use. Grinding is expensive due to the high wearing rates and mixes containing grog can be very abrasive. This tends to retard its use but excellent results can be expected when the added costs are not prohibitive.

Gypsum. (See Plaster of Paris)

Glucose

A vegetable sugar that can be used as a binder in clay bodies. It is a Carbon-Hydrogen compound that exhibits similar properties as starch and dextrine. (See Binders.)

Iron Chromate

$FeCrO_4$. Mol. st. 171.85. Ferrous chromate is used with cobalt oxide in under-glaze blacks, and also makes good black stains which may be added to a body. Iron chromate is also used to color engobes and has been a constituent of Cone 6 cherry brown and also dark pink overglaze polychrome. Brown and black colors in glass are also produced by iron chromate.

Iron Oxides

FeO, ferrous oxide; Fe_2O_3, ferric oxide, hematite; and Fe_3O_4, ferrous-ferric oxide, magnetite. The oxides of iron produce dark brown colors generally. Very finely divided iron oxide is responsible for the red color common in clay products, but larger particles give brown or black slag spots which may detract from appearance.

For this reason, much expense and processing is incurred in the removal of iron oxide from all types of ceramic raw materials, sand, feldspar, nepheline syenite and practically all other white-burning minerals. Some work has been done on the removal of iron from clays by complicated procedures but none of these has as yet reached commercial production.

Heat treatment can affect the final color of brick containing even small percentages of iron. Mainly, these techniques are known as "flashing" and consist of manipulating the oxygen content of the atmosphere at certain critical temperatures.

Iron acts as a fluxing agent and small quantities can lower P.C.E. drastically and for this reason must be kept out of refractory products.

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Kaolin

(China Clay) ($Al_2O_3 : 2SiO_2 : 2H_2O$.) This material fires to a white color and has a cone equivalent of 34-35.

The name, kaolin, comes from the two Chinese words Kao-ling, meaning "high ridge," originally a local term to describe the region from which the kaolin or "china clay" was obtained. The term was originally used in this country to refer to certain residual clays of a white or nearly white-burning character. In recent years, however, it has been stretched to cover certain white sedimentary clays like those obtained in South Carolina and Georgia. The present terminology differentiates between the two types of deposits by designating as primary or residual kaolins those white burning clays formed by the weathering, in place, of feldspathic rocks, pegmatite dikes, granites, and the like found in the location of the parent rock. Secondary or sedimentary kaolins are those that were formed by weather, then carried by water and redeposited in another area. Thus the secondary kaolins of South Carolina and Georgia were deposited in the sea, in an area later uplifted to form the Atlantic Coastal Plain.

Most of the domestic supply of residual kaolin is obtained from western North Carolina, and most of the sedimentary clay comes from Georgia and South Carolina. Many deposits of china clay are found in England and this material has for many years been a serious competitor of the domestic product. The American clay usually has finer grain and greater plasticity, therefore greater strength.

S. C. and Ga. china clay has been used throughout industry for years. It is one of the most uniform kaolins to be found. Generally speaking, there are two types of Georgia kaolin, one imparting unusually high strength and plasticity used where a high degree of workability is required. The other type, generally the fractionated controlled particle size clay, behaves well, dries uniformly, and reduces cracking of ware.

In 1950, 1,751,000 tons of domestic kaolins, valued at almost $24,000,000, were consumed in the U.S. Of this total it is estimated that the refractory industry uses some 9 percent.

When used as part of a refractory mix, the kaolin is sometimes supplemented with ball clays which improve the plasticity of the mix and strength. These improvements in handling characteristics are made with a sacrifice of refractoriness otherwise expected from kaolin used alone.

In many brick plants, local kaolin deposits are worked and the crude kaolin mixed with other clays or shale, to secure pastel colors. An additional effect of such mixtures is to raise the maturing temperature of the body and the range in which a satisfactory product can be produced. In the production of clay pipe, the increase of maturing temperature sometimes improves the glazing operation to a marked extent.

Kaolin can be used as a clay source in the preparation of engobes and slips. The extreme whiteness of the kaolin coupled with its high refractoriness allows the preparation of pastel colors maturing in a wide range of temperatures. In these uses, the low shrinkages during drying and firing are qualities that should not be ignored.

Kaolin, Florida

(Ball Kaolin). The kaolin deposits of Florida are found in the north central part of the state. They are mixed with white silica sand and pebbles. These deposits will average about 15% to 20% clay. When the sand and pebbles have been washed out, there is only 1½% to 2% clay solids in the stream going to the thickening vats. This provides a tremendous averaging effect and also results in a clay of high purity and cleanliness.

Florida kaolin has unusual physical properties not ordinarily associated with most kaolins. It can be described as a ball-kaolin. It has the refractoriness and high white fire color of kaolin coupled with the strength, workability and particle size distribution of a ball clay. This type kaolin has a greasy property that, together with a very fine particle size, gives it a very high degree of workability. It is very clean and uniform.

Florida kaolin is used in jiggering and extrusion processes where a high degree of workability is required. Excellent flowing properties make it very useful in dust press operation. It is used in bodies where high strength is required. It has excellent suspending power and is widely used in glazes. The low titanium content makes it desirable in colored bodies and colored glazes where greater purity of color in pastel shades is desired. Small percentages in casting bodies are helpful, acting as buffer for the electrolyte.

Kaolinite. (See Kaolin)

Lead Carbonate

(White lead). $PbCO_3 \cdot Pb(OH)_2$. Mol. wt. 776, sp. gr. 6.7, and decomposes at 400°C. Insoluble in water, slightly soluble in aqueous CO_2 and soluble in acid. It is a white powder, which is prepared by treating lead with acetic acid and carbon dioxide. The carbon dioxide is often generated by the fermentation of waste tanbark, which material sometimes gives a pink stain to the lead carbonate.

Modern methods of producing white lead use purified carbon dioxide produced by controlled burning of fuel and avoid the tanbark contaminations.

Lead carbonate is an important constituent of glazes. It is preferred by whiteware, earthenware and vitreous tile manufacturers to other lead compounds. Smaller amounts are used in enamels and glasses. Lead carbonate has advantageous purity, particle size, water dispersive and suspensive qualities. Fine size particles cause better suspension in raw glazes and quicker and more homogeneous fusions in frits. Due to high specific gravity of the oxides, difficulty in maintaining suspensions may be caused. The release of CO_2 and H_2O gas from lead carbonate under heat gives a degree of mechanical mixing and leaves the lead in a condition favorable to rapid chemical action which chemists describe as nascent. This is probably the cause for lead carbonate showing more rapid fusion.

Lead Oxide

Two types of lead oxide are used in ceramics, litharge or lead monoxide and red lead. Litharge, PbO has a mol. wt. of 223, sp. gr. of 9.3-9.5 and a melting point of 888°C. Insoluble in water but soluble in alkalies, certain acids and some chloride solutions. Red lead Pb_3O_4 has a mol. wt. of 686 and sp. gr. of 9-9.2 and it decomposes between 500° and 530°C. It is insoluble in water and is decomposed in some acids, leaving insoluble lead peroxide.

Lead and its oxides and other compounds are derived from the mineral galena which is mined in Kansas, Missouri, Idaho, Utah, Oklahoma, Mexico and foreign locations.

Lead has many advantages as a glaze ingredient, which results in its continued use in spite of the hazard to the worker. The superiority of lead glazes lies in their brilliance, lustre and smoothness, which are due to their lower fusion point and viscosity. Lead glazes are resistant to water solubility and chipping, and have few faults in texture and bond. They have high mobility, refractivity and elasticity, and are softer than leadless glazes. Lead glazes are said to be more "fool proof" in the plant, since errors in processing and composition affect the properties of the finished ware to a lesser degree.

All investigators agree that the use of fritted glazes, in which all of the lead is fritted, has important health advantages. In this way the raw lead is converted into relatively harmless lead silicates which are much less soluble in dilute acids or the gastric juices. Lead silicates are more slowly absorbed after entering the respiratory system, and can be eliminated with less lead absorption. Of the lead silicates, the bisilicate is much less soluble than the ortho-silicate or the mono-silicate. When dustless lead silicate is used in place of lead oxide, the lead hazard is practically nonexistent.

Lead Silicate

(Lead bisilicate or lead monosilicate.) Two types of fritted lead silicates are available for use in raw glazes, and enamels. (A) A 15% SiO_2, 85% PbO composition which is approximately the eutectic mixture of lead orthosilicate ($2PbO : SiO_2$) and lead metasilicate ($PbO : SiO_2$). It melts at 725°-775°, and is free from uncombined lead oxides and silica. This material is sometimes called lead mono-silicate. This is not strictly accurate since lead monosilicate would more properly refer to the lead metasilicate composition ($PbO : SiO_2$). It is used, however, to distinguish the basic lead silicate from lead bisilicate. (B) A composition of 65% PbO, 34% SiO_2 and 1% Al_2O_3. This material is commonly called lead bisilicate. Either of these materials offers a number of practical economies in plant production and allows the introduction of lead, with its consequent benefits, in an easily handled, dustless and safer form. The mechanical and volatilization losses of lead are thereby reduced to the minimum. The monosilicate can be used competitively from a cost standpoint to replace lead carbonate, red lead or litharge.

Lead Silicate, Hydrous

"$PbSiO_2$—$Pb(OH)_2$, mol. wt. 807, sp. gr. 5.8-6.5. This material has been put on the market as an alternate or replacement for basic carbonate white lead where the evolution of CO_2 from the carbonate is undesirable. It is a fine particle size powder of high purity and is prepared by milling and hydrating "lead monosilicate" under controlled conditions. It has been found useful as a mill base addition because of its freedom from gassing; good dispersion; and excellent suspension qualities.

A glaze can be made for sewer pipe using lead silicate and up to 40% of the native clay as a base in addition to other glaze constituents. This glaze, while more expensive than normal salt glazing, produces higher strengths and more attractive glazes.

Lepidolite

Commonly called "lithium mica," this compound is a lithium-potassium-aluminum fluorsilicate: $LiF : KF\ Al_2O_3 : 3SiO_2$. The theoretical lithia content is 6% plus but actual samples run about 4% due to partial alteration of the mineral and partial replacement of lithia by soda and potash. It is found chiefly in California, Colorado, South Dakota, New Mexico, Rhodesia and Southwest Africa.

Lepidolite may be used to brighten most glazes. It is added with flint at the expense of feldspar on a balanced alumina-silica ratio basis. High grade lepidolite is available in large quantities.

Lignin, Lignin Extract. (See Binders)

Lime

(Calcium oxide, whiting) CaO. Mol. wt. 56 and sp. gr. 3.4. Lime as CaO is not found in nature. Calcium carbonate, which is the chief source of lime, is found in the form of the mineral, calcite. Impure calcite occurs as rock limestone in large quantities in many parts of the world. Limestone may vary from pure calcium carbonate to pure dolomite, $CaMg(CO_3)_2$. Commercial lime may contain as high as 45% magnesia and such impurities as silica, iron oxide and alumina. Commercial limes are classified according to their relative content of CaO and MgO, as follows:

High calcium lime—less than 5% magnesia.
Magnesia lime—5-25% magnesia
Dolomitic lime—25-45% magnesia.

A lime carrying less than 5% total of silica, alumina iron and so forth is a rich lime. Use of the term lime, in ceramics, generally infers some ground limestone sold as whiting.

Limestone occurs in many parts of the world, some of the purest being found near St. Louis, Mo., and in Kentucky. As whiting, lime is found in England as a defined chalk, such as the chalk pits

of Dover. As dolomite it is found in various parts of the world and in this country the best known deposits are in northern Ohio. Wollastonite is a form of calcium silicate and at times it is said to constitute the chief mineral of the rock mass. This type of limestone is found in California, in the Black Forest of Germany and in France.

A number of terms are in general use for the different varieties of limestone based on differences of origin, texture, composition and so forth. The more important are as follows:

Marble is a limestone which is more or less distinctly crystalline. A marl is a loosely cemented mass of lime carbonate with clay and usually found in lake basins. Oolitic limestones are so called because of their resemblance to a mass of fish roe and are made up of small rounded grains of pure lime carbonate. Chalk is a fine grained limestone composed of finely divided calcium carbonate from shells. Argillaceous limestones are those in which silica is present in combination with alumina.

It may be said, regardless of the impurities that are found in limestone, that lime is in all cases practically the only base found in a pure theoretical limestone. In the dolomitic lime the base is some value between magnesium and calcium in certain definite proportions very close to 56 of calcium carbonate and 44 of magnesium carbonate.

In a leadless type of matt glaze, calcium in combination with chrome stain produces a fine green. Calcium and zinc produce a pinkish to brownish shade, while calcium and barium produce a dark green. Calcium and magnesium produce a brownish shade, and calcium and lead produce a fine bright green.

In the regular type of bristol glaze with a low feldspar content, that is, lower than .4 equivalent, maximum gloss is obtained when the ratio of CaO to ZnO is less than 1:1, while with high feldspar the ratio of calcium to zinc must be higher, that is, at least 3.1.

Lime is used in the production of silica brick. It is added either dry to the mixer or suspended in the water added to the batch. It acts to bond the nonplastic quartz grains together before firing and, more importantly, exerts an important influence on the conversion of quartz to the higher crystalline forms of silica.

The material, finely ground, can be added to red firing clays used for brick or tile. Used in this manner the effect of iron as a coloring agent can be minimized or overcome, resulting in a light pink or yellow and dirty buff. Flashing procedures will affect the final color. However, the safe firing range will be reduced at the same time and the maximum temperature that the ware will stand is also reduced. Over firing will result in sudden and catastrophic vitrification.

Lime in the form of nodules of any great size occurring in clays will seriously impair the economic utilization of that clay. Such stones, if burnt in the brick, will, when exposed to the air, hydrate and the increase in size will fracture the exterior face of the unit. When occurring as a strata of limestone in a pit the entire strata can be picked out. Lime occurring as scattered stone in alluvial deposits can be removed with conical rolls if of large size and the smaller stones can be crushed to small sizes by running all of the material through smooth rolls. The harmful effects are minimized when the size of the lime is reduced.

Limestone. (See Lime)

Limonite

(Brown iron ore.) $2Fe_2O_3\ 3H_2O$. An impure hydrous ferric oxide; probably actually a group of substances of variable composition and colloidal in nature. Impurities are silica clay, manganese oxide and organic matter. The water content is colloidal rather than combined and, though variable, averages about 15%. Sp. gr. 3.4-4.0 and hardness 1.0-5.5. Limonite gives yellow and orange coloring to clays, though it is sometimes obscured by organic matter present. On heating to about 500°C, limonite is decomposed to red ferric oxide. Limonite automatically colors clay bodies in which it occurs. Occasionally the mineral is intentionally introduced to get iron oxide colors. Blue shale deposits often leach to a characteristic yellow on exposure to the elements and this color change is associated with the change of other iron compounds to limonite.

Litharge. (See Lead Oxide)

Magnesium Carbonate

Magnesite

(Magnesite) $MgCO_3$. The mineral magnesite has a sp. gr. of 2.9-3.1 and a hardness of 3.5-4.5. Chemically pure magnesium carbonate has a mol. wt. of 84.3 and sp. gr. of 3.0. It loses its carbon dioxide at 900°C, is slightly soluble in water and soluble in acids. Magnesite is quarried in Washington, California, Russia, Austria, Greece and Czechoslovakia. Magnesium carbonate is also produced from sea-water in California, on the Gulf Coast and recovered from brines in Michigan.

It is the major constituent of a group of refractory products, basic refractories, that are growing rapidly in importance and are used in cement kilns and the furnaces of the metal-producing industries. When used for this purpose, the magnesium carbonate is "dead burned" in rotary kilns to produce a hard dense pebble of varying size. This intermediate form is crushed and the particles graded to provide a mixture of particles according to a designed standard. The magnesium carbonate is then mixed with other ingredients including organic binders in batch mixers and brick are formed by the dry press method. Such brick are available as chemically bonded brick or as fired ware.

The chemically bonded brick are burned in service. An interesting phase of their production is the use of metal covers for a significant amount of them. Metal clad brick are reserved for areas of intense conditions. While more expensive than either clay or silica refractories, the added life and higher operation temperatures attainable with basic refractories seems to indicate the continued expansion of the use of this material. An important number of chrome-magnesite brick are being manufactured in which the magnesite is used with varying proportions of chrome ore.

In glazes, magnesium carbonate acts as a refractory up to a relatively high temperature when it becomes an active flux. The formation of magnesium silicate in glazes develops an elastic glaze and at the same time develops glazes with rather low coefficients of expansion. Very often magnesium carbonate is used to check the fluidity of a glaze. This is a desirable property when dealing with crystalline glazes. Magnesium carbonate also seems to improve adherence.

Magnesium Sulfate

(Epsom Salts). $MgSO_4 \cdot 7H_2O$. Mol. wt. 246.5. Soluble in hot or cold water. Magnesium sulfate occurs as the mineral epsomite; it is found in British Columbia and in Washington, and is found in brines in Michigan. This material may also be produced by the action of sulfuric acid on magnesite, dolomite or other magnesium rocks.

The most important ceramic use of magnesium sulfate is for setting up enamels. The proper amount of magnesium sulfate enables an enamel to be used for a long time without balling up, and it prevents the enamel from running on a piece of ware. Too much of it produces a dull finish and possible crazing. Further, magnesium sulfate in the slip causes rust on any iron containers.

The effect of magnesium sulfate addition has been noted on dipping slips and in one case the use of 3 cc of magnesium sulfate per quart resulted in a heavy application with good draining.

When used to set up or thicken a glaze or slip, it must be used with caution as the ideal amount is quite critical. Besides reducing running of a glaze from a coated surface, it serves to increase the storage life.

Magnesium sulfate is one of the causes of "dryer house scum" appearing on structural ware. Clays containing small quantities accumulate a thin coating of the salt on the surface of the ware when the water of plasticity is evaporated in the drying process. During firing, the soluble salt is dissociated, the SO_2 being driven off into the atmosphere and the magnesium forming complicated calcium-magnesium-silica compounds that are insoluble and show as white or gray marks on the exposed parts of the brick.

Control of this type of scumming is usually done with barium carbonate which precipitates the soluble compounds to form insoluble compounds thus eliminating the migration of the scum causing material to the face of the brick during drying.

Other control methods used have included covering the face of brick with paper which was then burned off in firing and the reduction of the water of plasticity.

Magnesium sulfate can be added to clay to produce the characteristic white marks of "dryer house scum" if there is a market demand for such material. Application can be made with feeders or dosing each load of material as it is used. Amounts required to produce any degree of scumming vary with clay and the conditions but small additions on the order of fractions of 1% have proven sufficient in some cases.

Magnetite. (See Iron Oxide)

Manganese Oxide

MnO_2. Mol. wt. 87 and sp. gr. 5. It is converted into MnO at 535°C, is insoluble in water and nitric acid and soluble in hydrochloric acid. It occurs in nature as the black mineral, pyrolusite, which is mined in Russia, Gold Coast, India, South Africa and in small quantities in several of the United States, including Tennessee, Montana and Virginia.

Manganese dioxide is much used in the face brick industry to develop gray effects in the body of buff firing brick. When used as a body stain, effect depends on the grain size of the manganese as well as the amount used.

Mesh sizes of 20, 40 and 80 are often used for speckling effect while air-floated manganese develops uniform gray tones. When used in larger proportions, dead black brick can be produced. When used as an additive to red burning brick, the effect is to make a rich red color, depending on the amount used.

In larger grain sizes, manganese can be added to glaze to develop texture effects as well as large black spots contrasting with the color of the glaze. Some producers use fine manganese to break up the monotone of glazes. In this service it tends to mask slight imperfections which would otherwise detract from the appearance of the units and will perhaps lower the rejection rate at the sorting and grading station.

Used as a color constituent it can produce pinks and browns as well as purples, depending on its associated compounds. It is quite sensitive to minute changes in firing conditions.

Mica

A general term used for a large group of materials making up a major division of clay minerals. Generally regarded as impurities in finer clays and subject to removal by washing, illites or mica may in structural clays be the major clay-like mineral present. It has characteristic endothermic peaks by which the presence of the mineral can be determined.

More specifically mica is used for the material that splits into characteristic sheets of considerable size and is used in industry as insulators and dielectrics.

A form of considerable interest to the structural field and to refractories is vermiculite, a form of mica that on rapid heating expands 16 times accordian-fashion to form a light and inert material suitable for inclusion in lightweight structural bodies and as a grog in refractories or as an aggregate for the production of lightweight casting refractory concretes.

Molasses

A complex organic material derived from the refining of sugar from sugar cane. It has been used as a binder in the preparation of silica, magnesite and carbide refractories. In this use molasses has two effects. One is to increase the plasticity of the body during the forming operations reducing losses due to handling; when dry the body containing small additions exhibits much greater strengths and during firing the additive burns away without affecting the composition of the body.

Mullite

$3Al_2O_3 \cdot 2SiO_2$. Sp. gr. of 3.16. It occurs in nearly all fired ceramic products containing alumina and silica but is seldom introduced as such, except as calcined kyanite which is converted into mullite in calcination. Mullite is rare in nature, one locality being the Isle of Mull, Scotland, where argillaceous sediments have been fused by igneous intrusion. The compound was formerly thought to be synthetic sillimanite, which name still persists in some quarters. Mullite is very refractory, breaking up into corundum and liquid silica at 1,810°C.

In the manufacture of refractories, the desirable mullite is formed from the chemically similar minerals, andalusite, kyanite and dumortierite, which decompose into mullite and silica at Cone 13, Cone 12, and Cone 6, respectively. To break up sillimanite in the same way, Cone 20 is required.

Mullite bodies show a uniform rate of thermal expansion and are resistant to spalling and deformation under load. Their strength is due to the

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interlocking of long, needle-like crystals. Some authorities recently stated that to get long crystals there must be present impurities which will promote their growth, therefore a mullite body with short interlocking crystals is more stable at high temperatures.

Nepheline Syenite

A holocrystalline granular igneous rock made up of nepheline ($K_2O : 3Na_2O : 4Al_2O_3 : 9SiO_2$), potash feldspar (microcline), soda feldspar (albite), and such minor accessory minerals as mica, hornblende and magnetite. It is found in New Jersey, New Hampshire, Virginia, Montana, Canada, India, Russia. It resembles granite in texture but contains no free quartz. An analysis of the commercial ceramic nepheline syenite from Blue Mountain, Ontario, is:

Loss on ignition	.3%
SiO_2	60.0
Al_2O_3	23.2
Fe_2O_3	.06
CaO	.3
MgO	Tr.
Na_2O	11.1
K_2O	5.0

This analysis represents the commercial material after removal of iron. The iron content of the original rock is in the range of 2 or 3%.

First quality nepheline syenite starts to sinter at cone 08 and has a PCE of about cone 7. There is a eutectic between soda feldspar and nepheline which is a factor in the wide sintering range of nepheline syenite.

In the past decade, nepheline syenite has found some application in glazes for structural clay products, including facing tile, terra cotta, ceramic glazes for sewer pipe, etc. In low temperature glazes where fritting is not done, nepheline syenite is especially helpful in promoting the maturing of the glaze due to its relatively low fusability.

Some high iron grades of nepheline syenite have been used for making sand face brick, imparting a textured, granular, decorative effect to the brick's surface.

The nepheline syenite is usually mixed with coloring oxides and some sand. Its primary role is to form a fired bond between the sand grains in the coating and the body of the brick. It also acts as an "extender" for the expensive mineral oxides.

Work done by Everhart at the Ohio State University Engineering Experiment Station showed that additions of 2.5 to 5% of nepheline syenite to the clay as a body flux gave acceptable absorptions and fired strengths that are obtained at substantially lower temperatures without accompanying reductions at the upper firing limit. This, of course, results in longer maturing ranges. At the same firing temperature sizable reductions in absorptions and increases in strength are secured.

A paper presented by Wilson and Koenig of the Ohio State University Engineering Experiment Station at the 59th Annual Meeting of the American Ceramic Society, Dallas, Texas, May 1957, reported on the use of nepheline syenite tailings in sewer pipe bodies. Their report dealt with minus 30 Mesh tailings from the high intensity magnetic separators used in preparing first quality nepheline syenite for use in glass and whiteware production. These tailings contain 2 to 3% Fe_2O_3 and are ground to a point where approximately 99% passes a 200 Mesh sieve. The authors reported that when fired to cone 02 and above, the additions of ground nepheline syenite tailings to fire clay and shale bodies provided lower absorptions, improved flexural strengths and longer maturing ranges.

The thermal expansions of a fire clay and shale sewer pipe body were significantly increased by additions of ground tailings—the effect was greater at lower cones than at the higher cones. The ground tailings also helped to reduce the free quartz content in the bodies.

When firing below cone 02 the additions of ground nepheline tailings to the clay and shale bodies affected the unfired properties thus acting in the role of a refractory grog.

The authors further reported that the commercial production of sewer pipe using a body containing 5% of the ground tailings and firing to cone 3 has confirmed the laboratory results regarding the lower absorption and increased flexural strength derived from the addition. A large reduction also was noted in the number of cracked pipe when the tailings were used. The reduction in the number of cracked pipe, according to the authors, may possibly be related to several factors, namely:

a. A slightly lower drying shrinkage and resultant drying strains owing to the non-plastic addition.
b. A reduction in the amount of free quartz present in the body owing to the absence of free quartz in the nepheline syenite, and
c. A reduction in the amount of free quartz in the body introduced from shale or clays as a result of the solution of the quartz by the additive (nepheline syenite) during firing.

Ochre

Natural occurring stains which are for the most part hydrated ferric oxides mixed with clay and/or sand in varying amounts. They can be used as coloring agents for engobes or "sands" applied to face brick and have in the past been used to color the "salt" coat applied to ware that resists salt glazing. In this technique fine, 60 mesh or less clay prepared from the native clay is mixed with ochre and applied to the surface to "catch" the salt glaze.

When ochres carry much manganese they grade into the umbers.

Opacifiers

Opacifiers are those materials used in glaze to produce an appearance usually called opaque, although they really possess translucency rather than opacity. Originally tin was the major material used to opacify glazes but more recent techniques make use of compounds of zirconium and titanium which provide similar results at less cost.

Orthoclase

$K_2O : Al_2O_3 : 6\ SiO_2$. A potash feldspar useful when the total quantity of sodium must be limited. (See Feldspar.)

Petalite

Lithium-aluminum silicate has the formula $Li_2O : Al_2O_3 : 8SiO_2$ and a density of 2.4. It contains 77.0% SiO_2, 17.5% Al_2O_3, 4.3% Li_2O and 0.5% other alkalies.

Petalite can be added up to 45% in semi-fritted glazes, resulting in a clear bright texture maturing at cone 02 up to cone 5. Petalite is effective in clear and opaque raw single fire glazed to cone 12.

When natural petalite is heated above 1,000°C there is an irreversible crystallographic inversion into a solid solution of silica in beta spodumene. This unique structure has virtually zero thermal expansion and provides the basis for low expansion ceramic bodies of unexcelled heat shock resistance.

Within the lithia-alumina-silica system there exists a broad compositional area of low-to-zero thermal expansion. Negative expansions are encountered in certain area. Such bodies can, of course be synthesized from pure chemicals and a wide variety of expansion characteristics can thus be obtained.

Because of these behaviors, petalite can be added to refractory mixes to improve their resistance to thermal shock. Such additions lower the P.C.E. of the refractory body but result in much longer life of refractories subjected to repeated severe temperature changes. Other lithium bearing ores such as ambyganite and spodume can be used in the same manner.

Plaster of Paris

Calcined Gypsum, Calcium Sulfate.) $CaSO_4 : \frac{1}{2}H_2O$. A white, gray, or pinkish colored powder prepared by heating gypsum ($CaSO_4 : 2H_2O$) to remove three fourths of its water of crystallization. Available in various types of products having specific, controlled properties. When mixed with water and allowed to rehydrate to the dihydrate there is no apparent action at first, but soon a slight stiffening takes place and shortly after that it "sets" to a solid mass. As set progresses the mass begins to heat and expand, and final set is not reached until the evolution of heat has ceased and expansion is complete.

When suitably compounded with refractory substances, molds for the casting of non-ferrous alloy such as white metal, aluminum, brass are made with plaster. It is used in the manufacture of low density insulation and to provide green strength to mixtures of clay and non-clay refractories. In this use it can provide the set required to capture the frothy nature of lightweight refractories.

Much used by the manufacturers of finer ceramics for molds used in casting and jiggering processes, plaster of paris finds similar but less extensive use in the casting of complicated refractory shapes and for short run ramming molds.

Terra cotta shapes are formed in these ramming molds also and the same techniques can be used to make special brick shapes.

At elevated temperatures the sulphur is driven off and the material reacts as lime when used to bond bauxite, chrome or silica brick. In silica brick this is an important effect and the setting properties of the material enhance dry strength. The sulphur freed from the ware reacts with water to form sulphuric acid and is objectionable.

Potash

K_2O. Mol. wt. 94.2, sp. gr. 2.32, is very soluble in water and other solvents. The most important original source of commercial potash is natural potassium salts, which are mined in New Mexico, California, Germany, France and Russia. These are prepared as potassium nitrate and potassium carbonate for use in ceramics, but most of the potash is automatically introduced into batches in feldspar.

Its use, other than as a conditioner for clay, slips, engobes and as a glaze constituent, is in the elimination of green efflorescence on buff brick. If brick subject to green efflorescence caused by vanadium salts are treated with potash they will not develop the characteristic stains. A usual treating procedure involves dipping cubes of fired brick in a dilute solution of water and potash. When completely saturated, brick are removed and allowed to dry. The literature mentions a .4% solution although doubtless the proper amount will depend on total amount of soluble salts present in the brick and the absorption of the brick.

Potassium Carbonate

K_2CO_3. Commonly called pearl ash or potash. Mol. wt. 138. Although formerly imported, all domestic requirements at present are being supplied by American producers who distribute a product made from the electrolysis of potassium chloride from deposits located in California and New Mexico.

In this hydroxide or carbonate form, potash is an important deflocculating agent. It is used at ordinary temperatures to prepare casting slip, glaze slips, and engobes, to purify clay, to reduce the plasticity of excessively plastic clays, and to neutralize any acid present.

In glazes, potassium carbonate appears as an ingredient when it is desirable to modify the effect of a colorant such as copper oxide which may thus be brought through tints of green toward yellow. When potassium carbonate is used in colored glazes, it is advisable to frit about 90% of the clay but none of the color.

Rutile

TiO_2, Sp. Gr. 4.2-4.3 The mineral mined in several places in the United States and in several foreign countries is an important source for titanium oxide. However rutile contains 5% or sometimes less of various oxides of iron, chromium and vanadium. The material can be used to color clay products advantageously. Color developed depends on the mesh size of the rutile and the source, as varying amounts of impurities effect the results.

Granular rutile from Virginia will develop strong lavender colors and can be applied to stiff mud brick with sand blasting or as unground portions of engobe rolled, sprayed or poured on the column. Mesh sizes of 200 and 400 are available and will produce yellow and buff in small concentrations on the order of 10 to 15%, and larger additions to the sand will result in orange.

Used in the mold release send for the production of soft mud brick, extraordinary colors will be produced. Lower temperature maturing ware might require some type of carrier to insure superior adherence of the rutile colorant to the face of the brick.

Pyrophyllite

$Al_2O_3 : 4SiO_2 : H_2O$. One of the rather large family of hydrous aluminum silicates. Often confused with talc, as the two minerals have almost identical physical properties. However, pyrophyllite is an aluminum silicate, whereas talc is a magnesium silicate. It is very soft, with hardness zetween 1 and 2 and specific gravity of 2.8 to 2.9. It is found in North Carolina, Pennsylvania, California and Newfoundland.

Used in varying proportions as a part of refractory units where the very low rates of thermal expansion and contraction tend to increase resistance to spalling and cracking. The major difficulty in its use is the lack of plasticity of the material and the resulting loss to be expected in the forming operations.

Used in minor proportions in otherwise difficult clays it will increase or decrease the maturity temperature, depending on the impurities in the clays and pyrophyllite, and reduce shrinkage in firing. In glazed ware it is reported to reduce or eliminate crazing.

Sawdust

Purchased as mill byproduct in most cases, the purchaser is not able to always secure the type and kind best suited for the purpose he intends to use it for. Generally sawdust from soft woods will be larger in particle size than hard wood dust and usually not as suitable. Average weight of sawdust is 20 lbs. per cubic foot and is usually sold in units of 200 cubic feet.

Average moisture content ranges around 40% and when used as a component of structural or refractory products the heating value of the sawdust will reduce the amount of primary fuel required. One pound of sawdust will produce approximately 5,000 B.T.U. When particle size is important fines can be removed with air separating equipment and over size pieces or dust reduced to any desired size with grinders, crushers or hammer mills.

Sawdust can be used in the soft mud, the stiff mud and the dry press methods of making brick. Added in the pug mill or a mixer varying percentages of sawdust can be added as a method of reducing the weight of the product, increasing the drying rate and effecting economies in firing.

Used as early as 1885 in the U.S., sawdust and clay bodies were widely used in fireproofing tile production and was known as "terra cotta lumber." In some plants using a slop on the faces of the brick for architectural effect, sawdust is used on top of the slop or mud to prevent brick from sticking when they are 'faced." In this use sawdust can be spread mechanically.

Sawdust can be added to fireclays and the resulting mix made into any standard refractory size and fired. The density of the resulting refractory can be controlled by the proportion of the clay and dust but the compressive strength suffers as the unit is made lighter. Service temperatures are controlled by the fireclay used. Some sawdust is improved by roasting before use which can be done in rotary ovens but the charring should not be done above 600-650°. This tends to reduce the amounts of volatile material released from the mix during firing and eliminates all of the water vapor.

Used in structural clay products, the sawdust reduces weight, improves insulating properties and when used in large percentages produces a unit so porous that it can be nailed and cut with steel tools.

Primarily used in refractories to produce insulating units, lighter mixes produce good "U" factors but at considerable sacrifice in compressive strengths.

Silica

Silica occurs in a number of crystal forms, the nature and stability ranges of which have been extensively studied. This study has been difficult, partly due to the slow rate at which the changes occur, and the low thermal conductivity of silica and silicates, which tends to mask the results and prevent precise determinations. Sosman regards the allotropic changes as partly structural and partly atomic; he regards the sluggish changes as being due to the rearrangements of the silicon and oxygen atoms, and the rapidly reversible changes as being due to changes in the relative positions of the electron orbits which unite the atoms.

While tridymite and cristobalite may exist for indefinite periods of time at room temperatures, the low temperature or alpha form of quartz is the only form of silica truly stable at these temperatures. A considerable expansion accompanies the conversion of alpha cristobalite to beta cristobalite in the temperature range of 220-275°C and a sudden expansion of about 2.2% occurs during the inversion of alpha quartz to beta quartz at 573°C. The conversion of quartz to tridymite at 870°C is accomplished by an expansion of about 15%. These abrupt volume changes cause strains in a body containing free silica.

In recent studies at Alfred University and their ceramic college, it has been found that the crystal changes of silica are considerably responsible for the cracking of brick and tile in the heating up and cooling stages. Temperature curves can be so arranged that brick with high free silica content can be taken through the dangerous periods slowly and evenly to prevent any cracking or straining in the body.

The same phenomenon occurs in cooling. If a brick is cooled too rapidly and is subjected to these silica strains, it will be cracked throughout the cooling. Such a brick must have a longer cooling period to allow the complete transformation of the crystal to the more stable form.

BRICK AND CLAY RECORD in discussing firing curves, both in the Hanley story, 1955, and the Kelsey-Ferguson story, 1956, pointed out that brick can be cooled rapidly and heated rapidly in those stages where silica inversions do not occur and if organic substances are fired out. In both of these operations firing curves are very rapid, time is rapid and production is very high from tunnel kilns. The curves are based on proper knowledge of the silica inversion point.

All forms of silica, when heated to sufficiently high temperatures fuse and form amorphous silica glass or fused silica. If the heating is very rapid, quartz may fuse without appearing to pass through the intermediate stages. When fused silica is very slowly cooled, the reactions taking place are the reverse of those occurring during heating and alpha quartz will ultimately be produced

Very successful refractories have been made by adding fused quartz to the body. Quartz in itself, after it is fused, has a very low coefficient of expansion and actually assists in bringing out a good heat resistant type of body. There is a danger of recrystallization of quartz if reheated too high and too many times, which of course would destroy the low coefficient of expansion.

Silica refractories are made from gannister and quartz rock. These refractories are very commonly used in roofs of glass tanks and open hearths.

The rock is brought into the plant and ground up to a definite range of mesh. The silica then is mixed with a binder, sometimes even molasses, and then shaped into form either by dry pressing or by drop press. Silica is fired to approximately 2700° for the final formation.

Lime is sometimes used as the binder and acts as a flux too.

Two types of silica refractories are made, one of the ordinary variety and the second with very low content of alumina as a contaminating mineral. Alumina up to possibly 4% acts as a flux, bringing down the maturing temperature of the pure silica brick.

In some heavy clay products plants where clays are gummy and very fine grained, silica is added to open up the clay body.

Silica is used in all glazes as the chief, and often the only, acid radical (RO_2 group). It may be adjusted to regulate the melting temperature of the glaze. In common glazes, the ratio of silica to bases (RO group) is never less than 1:1 nor more than 3:1. By varying the relative proportions of the RO group and balancing the group against any desired silica content, the maturing temperature of a glaze may be quite closely controled. In other words, the fusability of the glazes used in the presence of equal proportions of fluxes depends on their relative silica contents.

Silicones

A series of compounds, poly siloxane, the structure of which has alternating silicone and oxygen atoms (Si-O-Si-). The structure is comparable to that of a carbon chain and, as in organic chemistry, the length of the chain and the degree of crosslinking determine the form of the silicone. Chains are longer and crosslinking is introduced and increased as the form moves from a fluid to a resin to a rubber.

The silicon atom has an atomic number of 14 and as such is normally tetravalent. The bonds which are not tied up in the polymeric network can be used to link organic components, the size and nature of which contribute greatly to the properties of the silicone.

The first step in the production of a silicone is the reduction of silica, SiO_2, to the silicon metalloid, by calcining or flux calcining sand in a furnace. The silicon is then reacted with organo chlorides to form organo-chlorosilane, which is hydrolyzed and polymerized to the desired material.

One of the outstanding properties exhibited by these unusual materials is a high water repellency which has been used for several years to waterproof existing walls and other porous structures. When walls are treated with silicone, they are still permeable to water vapor allowing any trapped water to move from the wall by evaporation and equalizing vapor pressures on both sides of the water repellent.

A technique of applying the silicone to individual brick has been developed which offers outstanding advantages to a large group of face brick manufacturers. By eliminating water migration through the brick, efflorescence from any source, brick, mortar, water or nearby concrete, can be eliminated and the finished wall will further resist air and water borne soil much longer than an untreated wall. As water is the major disruptive force, walls kept dry in this manner will resist spalling, and crumbling due to freezing.

Two methods have been developed to apply the silicone, spraying and dipping. The concentration of active silicone in the carrier must be worked out for each application.

Sillimanite

$Al_2O_3 : SiO_2$. This mineral, having the same chemical composition as andalusite and kyanite, is often confused with them. There are important differences in properties. Sillimanite has a specific gravity of 3.23 as compared with 3.16 for andalusite and 3.60 for kyanite. Both andalusite and sillimanite crystallize in the orthohombic form, while kyanite has a triclinic structure. Sillimanite has a hardness of 6-7, andalusite has 7.5, while kyanite varies from 4 to 7.

Upon heating, sillimanite decomposes into mullite and silica, but not until the temperature reaches 1545°C. On further heating to 1810°C the material breaks up into corundum and glass.

Soda Ash

(Sodium Carbonate, Sal Soda.) This salt has the basic composition Na_2CO_3 with mol. st. 106, specific gravity 2.53 and melting point 851°C. However, it may also appear as $Na_2CO_3 : H_2O$ (crystal carbonate) or $Na_2CO_3 : 10\ H_2O$ (sal soda). Soda ash has a theoretical solubility of 45.5 grams / 100 ml at 100°C but only 7.1 grams / 100 ml at 0°C.

Most soda ash is made by the Solvay process although a certain amount is prepared from lake brines and by electrolytic methods. "Commercial" grades of soda ash are available as 48% (Na_2O) light and dense and as 58% light and dense. Light and dense refer to apparent bulk density. Ordinary 48 to 58% grades are available in either light or dense but contain NaCl which may affect certain ceramic uses.

Soda ash is an active flux in ceramic glazes but can be used only as a frit ingredient because of its solubility. Na_2O added as soda ash in glaze frits supplements Na_2O from borax and feldspar components.

The deflocculating effect of soda ash in glaze frits supplements Na_2O from borax and feldspar components.

MODIFIERS Continued

The deflocculating effect of soda ash upon clay-water systems is an important phenomenon in several branches of ceramic body preparation.

In the presence of small quantities of soda ash the water of plasticity of bodies will be greatly reduced with consequent improvement in workability, greater green and dry strength and less cracking. This is particularly true where strongly flocculant ions such as Ca_{++} or SO_{4}— appear in the clay. High lime structural clay bodies are one example.

In this use they can be added in the pugging water or dry with accurate mechanical feeders to the clay any time prior to its delivery to the pugger. Fractions of 1% are usually all that is required.

In addition to the improvement of working properties of these types of raw materials the color of the fired ware is affected, usually to make stronger and more marketable shades.

Soda ash will react with massive lignite in certain ball clays to produce a very soluble and highly effective organic dispersing agent. Sodium silicate reacts much less strongly with massive organic inclusions so that under some circumstances soda ash is a far more effective deflocculant than sodium silicates. Normally, where lignite is low or absent, sodium silicate makes for lower viscosity than soda ash. Frequently, the two will be used in combination in a ratio suited to the type of deflocculation required.

Sodium Chloride

(Common Salt.) NaCl. Available in many qualities, bagged or in bulk. In most plant uses, lower qualities are quite satisfactory. Can be used as a bleaching agent in slips and glazes where it overcomes the effect of small quantities of iron oxide.

It is used in large quantities to glaze sewer pipe and, to a lesser degree, brick and tile. Not all clays are suitable for salt glazing. Barringer has reported that clay with a 3 to 8 silica to alumina ratio will salt glaze if sufficient temperature can be developed. The glaze itself seems to be 20% alumina, 54% silica with the balance being soda and other oxides.

In practice salt is applied as a vapor, created by throwing salt into the fire boxes of a periodic kiln after the kiln has reached a high heat. The salt vapor is carried into the ware area and condenses on all surfaces that it touches. In periodic practice, salting is repeated several times, the exact number of times is determined for each plant by experiment. As salting reduces the temperature quite rapidly the heat must be built up between saltings.

Salt vapor has a drastic effect on many refractory brick causing rapid failure mostly by dissolving the refractory. Insulating fire brick, by slowing condensation, delays this process. The amount of salt used varies widely with different clays, but generally 5-10 lbs. of salt per ton of ware seems to be sufficient.

Tunnel kilns can be salted, with salt vapors produced continuously in dutch ovens and pulled into the salting section of the kiln with a separate salt vapor exhaust system. Some plants inject salt into the salting section as a saturated water solution. In this installation, the volume change of the water vapor tends to build up a pulsating pressure in the section as the solution is added intermittently.

The salting temperatures of ware varies from cone 02 to cone 7 with the lower temperatures causing some difficulties. Salt glazing can be promoted by using a reducing atmosphere immediately preceding salting or by coating the ware with a "salt" coat which consists of finely ground clay applied to the face of the ware and which reacts more readily with the salt vapors.

Salt glazes are usually under tension which leads to crazing, lower pipe strengths and is not desirable. Additions of borax up to 10% reduce the tension and the defects resulting from it but does not eliminate them.

Under slips can be used in salt glazing and the color oxides can be mixed with the salt to develop colors not normally seen. The natural colors of salt glazes depend on the color of the body and firing conditions during firing, salting and cooling. They range from clear to black.

Sodium Pyrophosphate, Tetra

$Na_4P_2O_7$. A prepared chemical, containing no water of crystallization, available in granular and finely powdered forms. It dissolves in hot or cold water and is mildly alkaline in solution. It has a pH of 9.1 to 10.3. It is an efficient suspending and dispersing agent for grease, dirt, clay and other insoluble materials, which leads to its use in the ceramic industry. In clay slips the material is used as a dispersing and thinning agent. Approximately 1¾ lbs. are used to disperse a ton of clay.

It is used as a deflocculant in glazes and in the purification of clays. It is also used as a means of removing iron from clays by washing. It is an efficient water conditioning agent and as such may be used when the effect of hard water produces undesirable results.

Sodium Silicate

(Na_2O : x SiO_2.) A consideration of silicate of soda in the ceramic industry must be predicated on an understanding of what is meant by the term silicate of soda. In a commercial sense, silicate of soda is no more definite a term than clay. Its connotation is generic rather than specific. Attention must be called to this fact because in spite of voluminous literature there are still many technical men who think of a definite sodium silicate when they see the syrupy liquid of commerce.

Sodium silicate is made by melting sand and soda ash in a reverberatory furnace. Various proportions of the two ingredients are used and widely divergent characteristics result. The most alkaline liquid silicate made by this furnace process has a ratio of 1Na_2O to 1.6 SiO_2 and the most siliceous liquid grade has a ratio of 1 Na_2O to 3.75 SiO_2. There are more alkaline sodium silicates made which are detergents and are known as metasilicate, sesquisilicate and orthosilicate.

The melted sand and soda ash coming from the furnace may be put immediately into solution. The most silaceous grade cannot be concentrated beyond about 32% total solids without going to a gel, but the most alkaline liquid can be concentrated to about 61% solids and still remain fluid. Instead of forming solutions, the melt may be a cooled to a glass which can only be dissolved in high pressure steam.

Because of the many grades of silicate and the great differences in their characteristics, it is evident that the proper selection is of importance to obtaining good results, and the manufacturers are usually well equipped to give technical advice which will enable the user to obtain best results with a minimum of energy.

Sometimes for reasons of economy and many times for reasons of better workability or improved finished product, sodium silicates are used as additives in various clay products and refractories. The sodium silicates, liquid and powder, are beneficial in varied applications such as in casting slips, clay mining, refining and treating, bricks, enamelware and glazes, Faience tile, roofing granules and refractory cements.

In processing raw clays the deflocculating action of sodium silicate is used to separate impurities such as quartz, feldspar, mica, and iron oxide. One to four pounds of silicate per ton disperses the clay and permits the heavy impurities to settle out. The ore suspensions of deflocculated clay can be pumped to settling basins more economically than by other means of transportation.

Powdered metasilicate is added to the finished clay as a dispersant for the convenience of users.

Sodium silicate acts as a dispersing agent in clay suspensions to produce high fluidity and minimum water content. 0.1% of sodium silicate converts a stiff clay mud into a thin liquid which can be poured or pumped without difficulty. The reduction in water content of a cast slip results in a shorter firing time, less shrinkage or warpage of the finished ware, and greater strength.

Light weight insulating bricks are made from vermiculite or perlite by bonding with sodium silicate and calcium carbonate or similar reactants.

Silicates serve as a source of silica in porcelain and metal formulation. Since the silica has been fused with alkali, its use permits a reduction in the temperature required for fritting.

Silicates are used in Faience glazes to give artistic effects such as "crackle" or a fine crack design.

Silicates provide bonding strength at room temperatures. Powdered silicates are used in the dry clay type bonding mortars to be mixed with water just before use. Liquids are used with plastic chrome ore and other agents to formulate various types of furnace cements. Dry hydrated silicates are used with chrome ore formulations for gunning mixes to be used in patching while furnaces are under heat. Silicates provide temporary tack until the fusion effect of the other ingredients comes into play. They give greater green strength and greater fired strength in air set refractory specialties.

Sodium silicates are available in ranges from Na_2O : 3.75SiO_2 to 2Na_2O : SiO_2. Liquids range from 35.0° Baume to 67.5° Baume.

Starch

A group of carbohydrates or poly saccharides occurring in many plant cells. It is available in the form of a white soft amorphous powder. It is derived from several vegetable sources, corn being one of the more important. It finds use in structural and refractory products as a binder. (See Binders.)

Steatite

An hydrous magnesium silicate, being a massive variety of talc. Specific gravity and hardness are the same as for foliated talc. Steatite contains only about 3.75 to 4.75% combined water, so that firing shrinkage of the mineral is only about 4%. Therefore articles can be machined of crude steatite nuggets which are much more exact in dimensions than those made of porcelain mixes which have a greater firing shrinkage. The natural mineral may be machined to close tolerances to make ware from mined blocks, or it may be crushed into a powder and dry-pressed using a small amount of binder.

Sulfur

S. An element with atomic weight of 2.06, insoluble in water but soluble in a number of organic reagents. It is mined as native sulfur in Texas and Louisiana and Mexico as well as the volcanic regions of Italy, Japan and Chile.

Its compounds are sources of many difficulties to the structural and refractory manufacturer. Major trouble makers are iron sulfate or pyrites, magnesium sulfate and calcium sulfate. Materials containing these compounds evolve sulfur dioxide during firing and the gas combines with water to form sulfuric acid which destroys equipment and building. The balance of the compounds tend to mar the appearance and usefulness of the product in which they occur.

Tar

(Asphalt, pitch.) A complicated and variable material derived from petroleum as an end product of the distillation process. Tar has several uses in the refractory, brick and sewer pipe industries.

Its major refractory use is as a bonding agent in the production of carbon brick. In this use, the refractory mix must be heated to a point where the tar can be uniformly mixed and then the brick can be pressed in the usual manner. Patents and published material also illustrate some uses as a bonding agent for basic brick and in some cases silica brick. Carbon brick are often laid with a mastic type mortar containing tar. Tar is used as a convenient source of carbon in the "flashing" of periodic kilns.

When thrown into the fire boxes, dense clouds of black smoke are formed and it is likely that colloidal carbon particles are actually taken up into the surface of the brick.

In any event, the colors developed in this type of reducing atmosphere are different than when "flashing" is done without the use of tar. Salt added with the tar also affects the results, sometimes adding luster to the brick.

In the sewer pipe industry, tar is used as a joint material. Rings of tar on the bell and spigot ends are formed in the plant with metal molds. When used, the tar ring is washed with a solvent and the ends pushed together. The joint formed is not elastic but in non-severe use has proven to be satisfactory.

Terra Sigillata

A coating material prepared by decanting ground clay to retain only the smallest clay fractions. Clays so altered can be sprayed, rolled or dipped onto bodies of the same clay or from clay of different origin. On firing, the ultra fine terra sigillata forms a glassy phase at lower temperatures than the same clay of more usual particle size. Clay can be chosen for particular colors or for light firing material can be tinted with common colorants. When using terra sigillata on bodies prepared from the same clay, physical fit is assured and adherence is good.

Clay containing illite and kaolinite are best suited to produce terra sigillata material. The montmorillonites are not suitable.

Umber

An iron oxide coloring material containing significant portions of manganese. It is temperature sensitive and develops browns and blacks. (See Ochre.)

Vanadium Oxide

In special refractories, vanadium tetro oxide forms a number of refractory combinations with fusion temperature above 1540°C. V_2O_4. Tends to be unstable in air and V_2O_5 the resulting form has a marked reduction in refractoriness.

Vanadium can be used in glazes as a tinting color.

Salts of the metal have been blamed for the green efflorescence that sometimes appears on light colored brick. Control is difficult though some producers find dosing raw clay with fluorspar reduces or eliminates the problem. Others find treatment of fired brick with potash solutions inhibited the appearance of the green stains. Recent developments of plant applied silicone formulations to fired brick appear to be one economical way to control the migration of the salts.

Vermiculite

$(OH)_2$ $(MgFe)_3$ $(SiAlFe)_4$ $O_{10}4H_2O$. A peculiar type of mica that when heat treated expands 16 to 20 times its original size. The expansion is in one dimension much like an accordian. It is inert and is fairly refractory. Used as a grog in clays it reduces tendencies toward lamination and, being slick, acts as a lubricant for auger and dies.

Being resistant to fairly high temperatures it can be used as a grog for light weight refractory brick or as an aggregate for cast refractories.

The material occurs in South Carolina and Montana. It is shipped unexpanded after mining and sizing with the expanding being done near centers of use.

Volcanic Ash

(Volcanic dust, pumicite.) Volcanic glass blown into the air during the eruption of explosive types of volcanoes and deposited hundreds of miles from the source. The chemical composition of volcanic ash is similar to that of granite or rhyolite, but the rapid cooling of the material prevented the formation of minerals. This material occurs as a loosely consolidated gritty powder ranging in color from white to light gray. Deposits vary greatly in thickness and extent. The larger deposits contain reserves in excess of 100,000 tons and range in thickness up to 30 feet. Volcanic ash occurs in commercial quantities in Kansas, Nebraska, Oklahoma, Texas, Colorado, Idaho, Montana, Oregon, California and in British Columbia and Saskatchewan in Canada.

Volcanic ash is a naturally pulverulent material. Screen analyses of 70 samples from widely distributed areas in Kansas indicate that only 1 to 5% is retained on a 100 mesh screen and from 75 to 90% passes a 200 mesh screen. The pyrometric cone equivalent of Kansas, Oklahoma and Nebraska ash ranges from Cone 04 to 4, and this probably applies to volcanic ash in general, although one sample from Montana had a P.C.E. of Cone 8.

Its use in glazes is limited by the color change caused by the iron content but it finds use as an addition to clay bodies.

The use of volcanic ash in some types of sewer pipe bodies is advantageous because the low cost material permits vitrification over a wider range and imparts toughness to the finished product. The optimum percentage that should be used in a ceramic body of any type seems to be in excess of 7% but not more than 25%.

It lowers the maturing temperature of brick in the same manner and has been investigated as a ceramic bond in the production of lightweight aggregate clay block. Being extremely plentiful, the cost is attractive in areas where deposits are located.

Work indicates that the material can be expanded. A unique method reported indicates that the material can be mixed with the air of combustion and carried by that medium into the flame through an aspirating natural gas burner.

Whiting

Calcium carbonate prepared from certain sources. Originally from chalk cliffs in England, France and Belgium and then domestically from marbles or calcites. The term is being widened in use to include any fine calcium carbonate.

Witherite. Native barium carbonate. (See Barium Carbonate)

Zinc Oxide

The use of zinc oxide in the heavy clay industry is in glazes. In glazes for brick, sewer pipe, tile, etc., zinc oxide serves in several different capacities, all of which are beneficial in developing high-quality products. Dependent upon the glaze formulation, the firing procedure, and the characteristics of the body, zinc oxide plays an important role in developing different properties in a fired glaze.

Zinc oxide is used to reduce the coefficient of expansion of the glaze, thereby helping to make the glaze "fit" the body. Crazing of the glaze may thus be eliminated. It improves the elasticity of the glaze, thereby improving its resistance to mechanical and thermal shock. Because of its fluxing action and broadening of the maturing range, zinc oxide in glazes in proper amounts improves the gloss.

However, in larger amounts, in a properly formulated glaze, zinc oxide is used to develop various textured glazes such as matte, eggshell, or crystalline. Certain colors are developed or enhanced by zinc oxide, and it also functions as a secondary opacifier.

The last property to be mentioned is that zinc oxide helps to make a glaze highly insoluble. This is particularly important for heavy clay products. Insolubility of a glaze coupled with crazing control are to be considered as extremely important properties in a glaze applied to heavy clay products, whether they are used inside, outside, or underground.

Wollastonite

$CaSiO_3$. Sp. Gr. 2.9, 4.5 hardness on the Moh's scale and P.C.E. of cone 18. This is a naturally occurring silicate which has been used in comparatively large quantities in ceramic tile bodies, glazes and electrical ceramics. Recently it has been reported that the addition of as little as 1-3% to typical structural clay bodies results in improvements of forming, drying, firing and quality of finished ware.

The Wollastonite particle is needle-like and it is thought that a jackstraw effect tends to open the clay body to allow the escape of water vapor during drying and the early part of the firing cycle. During the later stages of firing the same effect is observed on the products of ignition.

The material can be added with an accurate dry feeder to the pug mill.

According to a paper written by Jackson and Vukovich, additions of 1-3% Wollastonite increased dry strength of structural clays up to 40% and in laboratory firing of test bars allowed the firing rate between 900-1100° F. to be more than doubled.

A reduction in moisture expansion of autoclaved test bars containing Wollastonite was noted and this reduction ranged from 30% of the untreated value for minimum addition to 66% for additions of 3% to one o the clays tested. This effect would be expected to reduce delayed crazing of glazed structural tile after long periods of service.

Zinc

Zinc metal is used for flashing colors directly onto the body of the clay ware. The only use it is put to in the heavy clay industry is in the development of "flashed" colors on building brick. A mottled arrangement of colors ranging from dark brown to a dull green to a sort-of-yellow can be developed by exposing the brick, during the firing cycle, to the action of zinc vapor. This can be affected by adding mossy zinc to the fire box where it is vaporized.

Zirconium Oxide

Mol. wt. 123 and sp. gr. 5.7. It melts at 2700°C and has a low thermal conductivity.

To prepare useful products from zirconium oxide, stabilizing agents such as lime or magnesia must be added to the zirconia, preferably during fusion, to convert the zirconia to the cubic form. Most commercial stabilized zirconia powders or products contain calcium oxide as the stabilizing agent. The "stabilized" cubic form of zirconia undergoes no inversion during heating and cooling.

Stabilized zirconia refractories are used where extremely high temperatures are required. The low thermal conductivity insures low heat losses, and the high melting point permits stabilized zirconia refractories to be used continuously or intermittently at temperatures above 4000°F in neutral or oxidizing atmospheres. Above 3000°F in contact with carbon, zirconia is converted to zirconium carbide.

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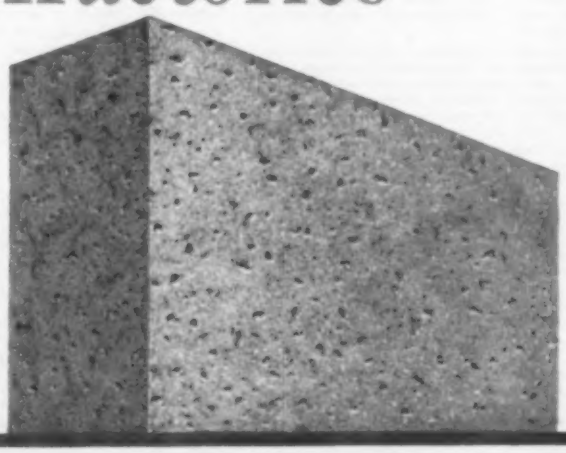

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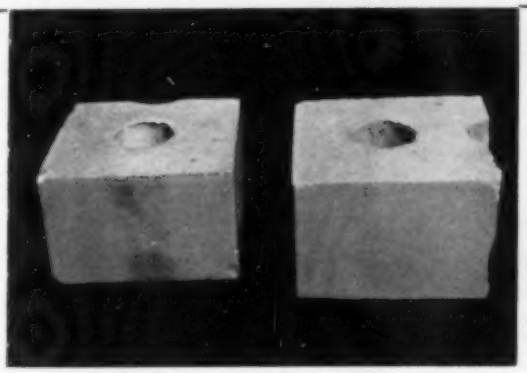
CONTROL GREEN SCUM with MINERVA FLUORSPAR



A little green scum can ruin a fine reputation. Here is an example of a beautiful light cream brick, fired at Cone #1 and with a 10% absorption.

In the case on the half brick at the left, no fluorspar was added and green scum developed after less than a month of outdoor exposure.

The half brick at the right was produced in the same way from the same materials, but with 25 lbs. of fluorspar added per ton of clay, or slightly more than 1%. The cost of the fluorspar additive was less than 50 cents per ton of clay.

MINERVA Ceramic Fluorspars are the recognized remedy for combatting vanadium green scum in buff, cream, pastel and white brick. It is particularly needed where delicate color control makes hard firing and resulting vitrification objectionable.

Fluorspar, when finely ground and thoroughly mixed with the clay at the dry-pan, acts as a flux at low temperatures, vitrifying the interior of the brick. Since green scum is caused by the oxidation of soluble salts of vanadium and iron, which have migrated from inside of a porous brick, upon alternate wetting and drying, the decrease in permeability through vitrification prevents these troublesome salts from being carried to the surface of the brick.

Ask for a trial sample of MINERVA FLUORSPAR to try on your own ware. MINERVA'S clay-consulting engineer is at your service on green scumming problems at no charge.

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Personal Notes

B. B. Brassell has been appointed assistant chief engineer of Texas Vitrified Pipe Co., Mineral Wells, Tex.

J. F. Dair, superintendent of the San Jose (Calif.) Brick & Tile Co., has been elected to the board of directors of both San Jose Brick and the Remillard-Dandini Brick Co.

James S. Cole, building products sales manager for Gladding, McBean & Co. in the Northwest and Spokane office manager for Gladding, McBean, has retired.

John E. Kempthorne has been appointed to the Refractories Div. sales staff of Robinson Clay Product Co. He will represent western Ohio and southern Michigan.

Charles F. Brown, Dr. Adam S. Borst and *Herbert G. Braasch* have been elected directors of Sayre & Fisher Co., Sayreville, N. J.

H. A. Desaix Dies

Herbert A. Desaix, 38, superintendent of the Barboursville Clay Mfg. Co., Barboursville, Va., was killed in an accident at the plant on Oct. 11. Desaix had been Barboursville superintendent since 1952. Prior to that time, he was with Hocking Valley Brick Co. and Allied Engineering Co.

L. F. Dyer Dies

Leonard F. Dyer, 65, sales engineer for Kaul Clay Co., representing Kaul in the Pittsburgh area for 17 years, died Oct. 12.

Mast Leaves Wadsworth

A. H. Mast, of Wadsworth (Ohio) Brick & Tile Co. since 1952, has resigned as superintendent. His future plans are indefinite, at last word.

Changes of Address

If you're due to change your address, be sure to avoid missing an issue of B&CR. Please notify us of your new address at least six weeks in advance of moving date. Write: BRICK & CLAY RECORD, 5 South Wabash Ave., Chicago 3, Ill. Be sure to give both old and new address, zone number, and your name.

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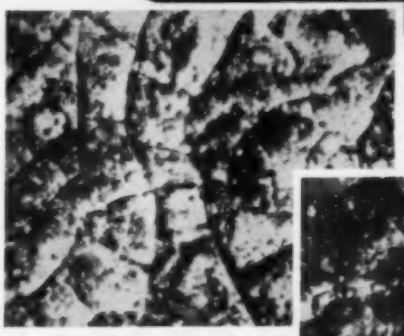

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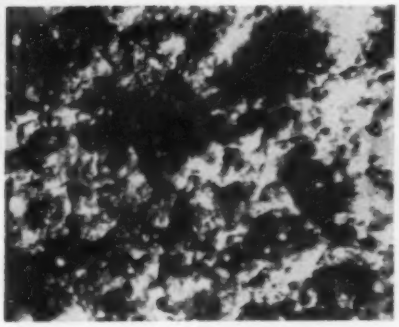
BADLY CRAZED

Here's proof of what a borate-salt mixture can do for your ware!



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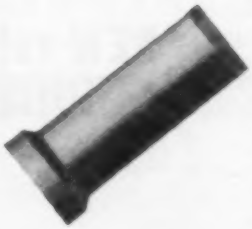

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PYROMETER — New test pyrometer is said to step up tunnel-kiln firing quality. Test car can be equipped with traveling pyrometer system to transmit readings, show actual firing conditions throughout tunnel kiln. A few trips by the instruments show you full firing picture. Bristol Co., Waterbury, Conn.

645/Circle on Reader's Service Coupon

PALLETIZED ULTROX — Ultrox and Ultrox 500 W are now available on expendable wood pallets for faster handling, easier storage. Pallets need no return, can be easily handled by one fork truck operator. Metal & Thermit Corp., Rahway, N. J.

646/Circle on Reader's Service Coupon

BEARINGS—The Timken name assures the buyer of getting tapered roller bearings, fine alloy steel bars, seamless steel tubing and removable rock bits of highest quality. Timken name is a trade-mark, not just a type of product. Timken Roller Bearing Co., Canton, Ohio.

647/Circle on Reader's Service Coupon

CAR WHEELS—S-D Floater wheels for kiln cars are smooth running, low maintenance wheels used in many plants, and designed specifically for kiln use. Have such features as completely closed outer hub with inner hub protected by two special grease seals to eliminate dust while saving lubricant. Sanford-Day Iron Works, Knoxville, Tenn.

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TUNNEL KILNS—The entire brick plant of Cloud Ceramics was built in a planned, coordinated production line featuring a Harrop tunnel kiln. Integrated operation produces 67,000 modular face brick per day with 402' tunnel, twin tunnel dryer with each tunnel 183' long, plus Harrop warming chamber that's 3-track, 173' long. Harrop Ceramic Service Co., Columbus, Ohio.

649/Circle on Reader's Service Coupon

STRAPPING — Signode has developed new system of semi-automatic strapping to allow one-man operation of strapping process. Strap feeds around package with no helper needed on backside. Strap is tensioned right automatically; one-stroke action cuts. Signode Steel Strapping Co., Chicago.

650/Circle on Reader's Service Coupon

CLAY DRYERS—Lanly can help clay product manufacturers to a better competitive position by replacement of outmoded dryers that cost time, money, product quality. Company makes humidity controlled fire brick dryers, refractory dryers, brick and pipe drying set-ups, designed to your needs. Lanly Co., Cleveland, Ohio.

651/Circle on Reader's Service Coupon

DRY PAN—The new Toronto dry pan features knee-action mullers to give space-saving linkage that keeps the entire interior of the pan open for introduction of material. Also keeps the mullers in vertical alignment for best crushing. Toronto Foundry & Machine Co., Toronto, Ohio.

652/Circle on Reader's Service Coupon

LUMNITE—Refractory concrete used in round-kiln flue system and floor substructure at Charleston Clay Products is reported to have cost 40% less than conventional construction, to be giving long, good service. Jointless side walls and floors of flues make debris removal easy. Universal Atlas Cement Co., New York City.

653/Circle on Reader's Service Coupon

TURBINE MIXER—T. L. Smith's turbine-type mixer is reported to be proved to be up to 400% faster in performance in the refractory industry, by test. Mixing time was four times faster, company says, with uniform blending, no excessive breakdown of particle size, other features. No dead center in mixing area. T. L. Smith Co., Milwaukee, Wis.

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665-International Clay Machry.
666-Clearfield Machine
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669-Nat'l. Paint-Mang.
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STREET.....

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This card void after January 28, 1959

SINTERING FANS—Fans for sintering, rotary kilns and other tough operations where erosion resistant fans are needed are made by Westinghouse. Fans are specially designed for handling abrasive gases at high temperatures and pressures. Sturtevant Div., Westinghouse Electric Corp., Boston, Mass.

655/Circle on Reader's Service Coupon

PRESS DRIVE — Multi-speed dry press drive combines two variable speeds to give better control over pressing, resulting in brick with higher density and uniform quality. Maker suggests use of drive in manufacture of dry press building block or brick. Ortruc, Inc., St. Louis, Mo.

656/Circle on Reader's Service Coupon

ZIRCON—A line of granular and milled zircon for refractory shapes, ramming mixes, cements in 140, 200 and 400 mesh sizes is available from Orefraction, Andrews, S. C.

657/Circle on Reader's Service Coupon

PULLEYS—Van Corp offers four face selections, standard crown, straight face, high crown and elevator face. You can choose the pulley that has proper face made specifically to fulfill your requirements. Van Gorp Mfg. Co., Pella, Iowa.

658/Circle on Reader's Service Coupon

BRICK FORKS—Priester brick forks are said to save time, money, labor by handling brick in units of any size. Automatic operation speeds brick handling in setting and drawing kilns, loading and unloading trucks and box cars. Bradney Machine Co., Middletown, N. Y.

659/Circle on Reader's Service Coupon

SCREENING—Universal screens are reported to give the best in screening at the lowest price, the maker says, with modern, efficient electric heating equipment. Universal Vibrating Screen Co., Racine, Wisc.

660/Circle on Reader's Service Coupon

REFRACTORIES — Gem engineers are available to help you develop new units, special refractory shapes or redesign of new pieces to reduce costs, and make assembly easier in production. Gem Clay Forming Co., Sebring, Ohio.

661/Circle on Reader's Service Coupon

LOADER—Tack-L-Hoist loading-unloading units are said to need only 30 seconds to hoist a load and haul it away. A fast way to stack o a load of brick, pipe, blocks can be equipped with forks to 48" in length. Tack-L-Hoist Co., Butler, Pa.

662/Circle on Reader's Service Coupon

BINDERS — Liquid Glutrin or powder Goulac increase molding and dry strength of brick, clay refractories, structural tile, sewer pipe, etc. Only small amounts are needed, so production is economical. Robeson Process Co., Erie, Pa.

663/Circle on Reader's Service Coupon

FANS—Robinson engineers can design an efficient air handling operation for your drying and firing set-up, based on the particular needs of your clay and processing methods. Hi-draft equipment can speed turnover in periodic kilns; lower fuel consumption, give better control. Robinson Ventilating Co., Zelienople, Pa.

664/Circle on Reader's Service Coupon

PRESSING — International presses feature mechanized operation in heavy duty pressing operations, eliminating hand operation and lowering production costs. Press has many features including safety features. International Clay Machinery Co., Dayton, Ohio.

665/Circle on Reader's Service Coupon

MIXER—The Clearfield mixer for ceramic and refractory materials uses a revolving bottom, gives efficient, economical means of blending and tempering. Dry to high moisture content mixes are produced with thorough diffusion of all components. Clearfield Machine Co., Clearfield, Pa.

666/Circle on Reader's Service Coupon

GAS BURNERS—New Hauck excess air gas burners offer exceptionally stable flame even with 1000% or more of excess air, maker says. Reported to give much higher forward velocity of gases for better penetration, circulation and distribution of heat; easy, positive ignition; easily controlled temperature. Hauck Mfg. Co., Brooklyn, N. Y.

667/Circle on Reader's Service Coupon

BUILDINGS — Varco steel buildings keep production costs down by giving expensive equipment good shelter. Quick construction methods for both new plants, modernization of old. R. G. Varner Steel Products, Inc., Pine Bluff, Ark.

668/Circle on Reader's Service Coupon

MANGANESE—Buff and light clays can be turned gray, red clays can flash to dark reds, blacks and gun metal shades with use of National manganese. National Paint & Manganese Co., Lynchburg, Va.

669/Circle on Reader's Service Coupon

DRYER CARS—By Chase are used at Illinois Clay Products where the maker reports less cost, longer-lasting use, with low initial investment and maintenance costs. Chase Foundry & Mfg. Co., Columbus, Ohio.

670/Circle on Reader's Service Coupon

CONES — Orton cones allow you to have a high degree of controlled standardization in manufacture. A reliable means of checking firing conditions in your kiln because Orton cones are uniform year-after-year. Orton cones in type to meet your requirements. Edward Orton Jr. Ceramic Foundation, Columbus, Ohio.

671/Circle on Reader's Service Coupon

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Goose Lake Adds Hydraulic Press

A new press of unusual design has been in operation at the Goose Lake plant of the Illinois Clay Products Co. of Joliet, Ill. Having proven itself after six months of steady service the company has placed an order for an additional unit of the same design but of greater pressure capacity for use in the production of its chemically bonded refractory brick.

Working with 2,000 pounds of hydraulic pressure, the press is able to develop a total pressure of 500,000 pounds on the press table with a ten horse power motor. When pressing brick with a depth of 4½ inches the unit can make eight cycles a minute and can cycle ten times, a minute when pressing splits.

The actuating cylinder is six inches in diameter, but its force is multiplied through a toggle mechanism to produce the high total pressures required in refractory work.

Automatic Operation

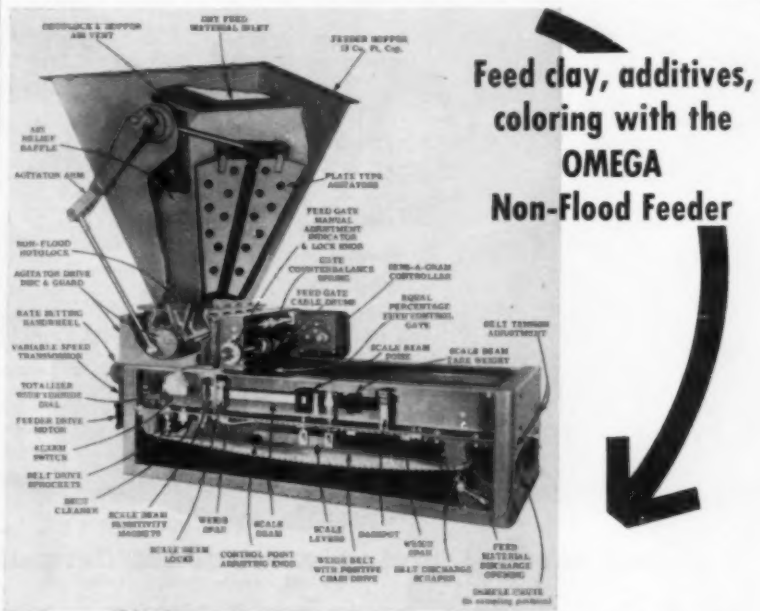
The two mold machine is automatic in operation with each step in the pressing sequence controlled with micro-switches. Any part of the pressing cycle can be skipped if the machine is over loaded.

The bottom plate is fixed vertically while the mold box moves up and down to push pressed brick from the machine and to fill the mold box for the next pressing.

In steps, the operation proceeds with the mold box moving backward in a depressed position. Then the mold box rises beneath the shaker box and forward to the pressing position with the refractory mix fills the mold box. Following filling, the mold box moves the fixed shaker box remaining stationary.

The pressing cycle starts with the filling of the hydraulic cylinder which moves the toggle. Any pause desired can be set into this action. After the pause to let trapped air escape, the toggle is closed exerting maximum pressure. As the cylinder retracts, the top pressing plates are withdrawn and the mold box drops to expose the brick and the cycle starts over.

Features include the accurate control of the "floating" mold box during the pressure stroke to develop sharp edges on both top and bottom of the brick. The press weighs less than 12,000 pounds and all parts are above the floor level.



HERE'S WHY Omega Belt Gravimetric (weighing) Feeders handle finely pulverized materials so dependably and accurately:

1. **ROTOLOCK** — positively prevents flooding.
2. **SCIENTIFIC HOPPER DESIGN** — large inlet throat ensures full material flow to the Rotolock.
3. **BULK DENSITY CONTROL** — built-in hopper agitators and air relief vent avoid bridging or arching in the hopper . . . further insurance of proper flow through feeder.

For DRY FEEDERS Bulletins 35-N62, 35-G5A

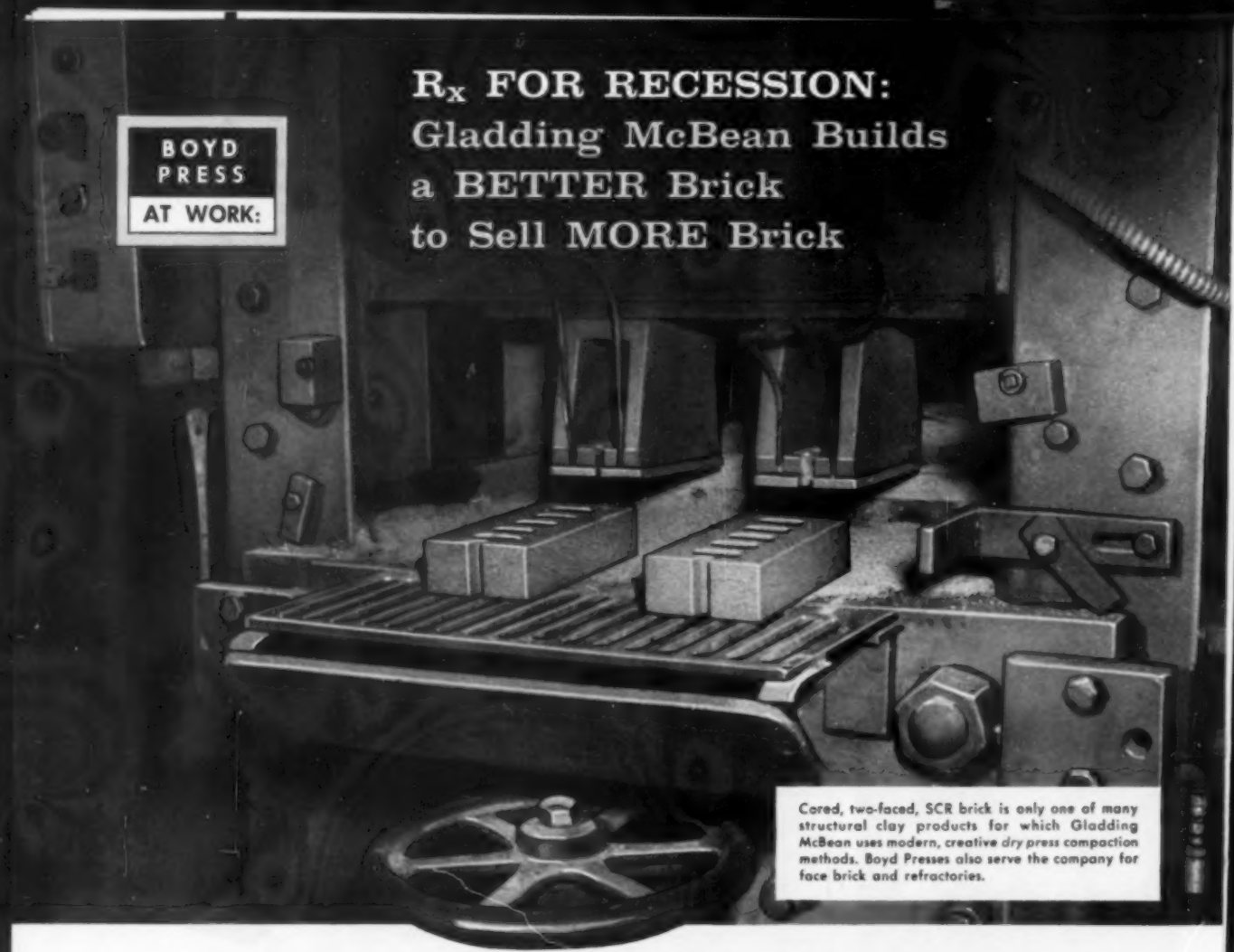
For LIQUID FEEDERS Bulletins 32-R2, 65-H12B

Omega Belt Gravimetric Feeders — in capacities from grams to tons per minute — are readily adapted for proportional feeding of many components . . . and for remote control from a central panel. Because they feed with ±1% accuracy by weight, they contribute to uniformity of end product — and help conserve valuable additives and coloring. For complete details write for bulletins. **Omega Machine Co., 407 Harris Ave., Providence, R. I.**

OMEGA MACHINE CO.
DIVISION OF
B-I-F INDUSTRIES
METERS FEEDERS CONTROLS

BOYD PRESS AT WORK:

R_x FOR RECESSION: Gladding McBean Builds a BETTER Brick to Sell MORE Brick



Cored, two-faced, SCR brick is only one of many structural clay products for which Gladding McBean uses modern, creative *dry press* compaction methods. Boyd Presses also serve the company for face brick and refractories.

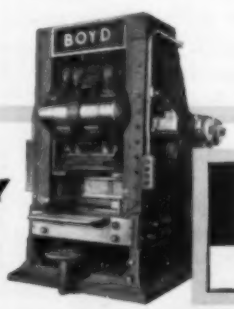
Busy Boyds serve growing west coast demand for dry press SCR

On the west coast, Gladding McBean has pioneered the production and the use of a two-faced dry pressed SCR brick, for building partitions—into an active, profitable market.

Boyd Presses at their Pacific Northwest Division are busy turning out a SCR brick in a variety of colors which boasts equal perfection on all faces, freedom from kiln markings and straight, square edges. The cored, dry press brick can carry conduit and steel and forms a partition wall of striking beauty, strength and utility.

Gladding McBean's experience is typical of the way in which leading brick and refractory producers are *taking* advantage of the real *profit opportunity* offered through creative, *controlled* dry pressing on the Boyd Press. Whether you're producing refractory, face brick, SCR or backing . . . with a Boyd *Power* Press, you *can't help* but turn out a product with smooth straight edges—because it's pressed out in a *die*. You set straight on the kiln car and less moisture is required so that drying time is less, shrinkage is reduced—dimensional stability is easier to attain and control.

Yes, the dry press era is here now. Why not see how a *step up* to BOYD can put *power* to work . . . in your profit picture? Write for details.



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BOYD POWER PRESS

Open Hearths Featured Topic At ACS Meet

Dean McMahon of Alfred talks with Pres. Bradley of ACS.

Topics include open hearth roofs, a design for P.C.E. furnace, jet exhaust testing programs plus temperature measurements.

Demands of open hearth operators for refractory roofs that will permit higher operating temperatures and thus allow the open hearth to remain competitive with electric furnaces were discussed at length at the Fall Meeting of the Refractories Division of the American Ceramic Society.

Scheduled activities extended from Thursday evening, Oct. 2, to the following Saturday noon at the Bedford Springs Hotel, Bedford, Pa.

In addition to a full series of papers on the use of fusion cast basic refractories in open hearth roofs, members of the Division heard two papers on temperature measurement and one on the development of a simulated jet exhaust of managable laboratory size by the National Bureau of Standards.

Social activities included cocktail parties, the banquet, golf match and a ladies' program which include a luncheon, card party and other entertainment. The attendance set a new record with 322 people being registered at the meeting.

Open Hearth Shop

Opening paper of the meeting was a general review of open hearth shop practice presented by Hank Bednarski. Two speakers, John Slaughter, Manager of Fused Ceramic Research of Corning Glass Works, and John Hazel, Chief Ceramic Engineer of Republic Steel, covered the progress that has been made in the use of fusion cast basic refractories.

Slaughter, speaking of the practical results to be expected from a study of the research information, noted that fusion cast basic refractory material has a growth phenomenon of .6 to .7% when unrestrained in use. The suggestion was made that greater expansion allowances should be made for this material than has been the practice with other materials. The high resistance of fusion cast basic to penetration by slag was brought out as well as the low porosity.

Hazel told of the experience of Republic Steel dating back to 1955 when the first fusion cast roof was installed and which included eight roofs in all. Major points brought out were the facts that design thinking is changing to accommodate the differing properties of the new material and the higher rates of production resulting from the higher operating temperatures permissible with basic brick.

P.C.E. Furnace

A tentative design for a P.C.E. furnace that would give dependable and reproducable results was presented by Lewis Mong in a paper written by him and D. M. Adelman. Both men are from the National Bureau of Standards. Major requirements for such a furnace were listed as: cone visibility, temperature distribution, temperature control, atmosphere control and cost. Currently available designs were studied and their evaluation, together with sug-

Continued on page 77

Square dancing was part of social end

From left, Mrs. Robert Limes, E. P. Snyder, Mrs. Robert Stevens, Mrs. Snyder.

New Officers: Seated at left, Pres. Taylor with 1st VP Wilson at his left. Standing from l to r are Treasurer Park, 2nd VP Thorssen, and Secretary Kennedy.

ESCSI Elects Taylor, Visits Plants

Kansas City meeting sees Carter-Waters, Buildex plants; hears committee and technical reports; membership now up to 36 companies.

An increase in the use of expanded aggregate in poured, precast and prestressed concretes was reported during the sixth annual convention of the Expanded Shale, Clay and Slate Institute at the Muehlebach Hotel in Kansas City, Mo. At the October 15-18 meeting the members of the Institute laid plans for an intensive promotion campaign which will bring to the attention of designers and builders the technical information that has been developed by the research program of the organization.

According to S. C. Smithwick, chairman of the promotion committee and editor of the Institute's *Concrete Facts*, over 200,000 copies of the different publications were placed in the hands of interested consumers during the past year.

Visit Carter-Waters

The Kansas City meeting was also devoted to discussion of technical applications, production techniques and the usual organizational actions. Plant trips to the nearby Carter-Waters lightweight plant, the Carter-Waters Concrete Production plant in Kansas City and the Buildex, Inc,. L. W. plant at Ottawa, Kan., were available to members who were free from the many committee meetings.

The members voted to hold the meeting in Toronto, Canada, in 1959 where they will be guests of Cooksville Co., Ltd. The Cooksville plant was the third lightweight plant built and is one of the oldest in use, built soon after the original Haydite plant was completed in Kansas City which has since been replaced by the present Carter-Waters plant.

The Technical Applications Committee reported that a handbook covering most of the uses and properties of lightweight concrete was nearing completion.

New officers of the Institute were elected. The presidency is being assumed by Allan Taylor of Kenlite, Louisville, Ky. New first and second vice presidents are Cedric Wilson, Texas Industries, Inc., Dallas, and LeRoy Thorssen, Consolidated Concrete Industries, Ltd., Calgary, Alberta. Lester Kennedy is the incoming secretary and Ben Parks remains as treasurer.

Carter-Waters Corp. and Buildex, Inc., were co-hosts at the convention and made arrangements for the social activities which included luncheon Friday and a cocktail party that evening and the annual banquet. Outgoing President Otto Frei of Georgia Lightweight Aggregate Co., Atlanta, was presented with a memento of his year's service to the organization and Frei relinquished the office. On Saturday following the meeting, members were guests of the co-hosts at the Oklahoma-Kansas football game at Lawrence, Kan.

The Expanded Shale, Clay and Slate Institute also increased its membership at this meeting and now represents 36 companies producing lightweight in rotary kilns. The association was formed six years ago and at that time had 12 members.

Vocational Guidance Counselors Guests at Pittsburgh Meet

Twenty-four high school vocational guidance counselors were guests at a joint meeting of the Pennsylvania Ceramics Association and the Pittsburgh Section, American Ceramic Society, on October 14.

The counselors were taken on a guided tour of Mellon Institute, with emphasis on ceramic research activities, including work on glass, enamels, refractories, electronic components, and structural clay products. Following the tour Ray Kerr gave a brief description of a display which indicated the importance and diversity of ceramic products.

A dinner followed at the Royal York restaurant. Each counselor received the personal attention of a particular member of one of the sponsoring societies, who served as host to take care of introductions and answer questions, etc.

After the dinner, Ed Ruh, vice chairman of the Pittsburgh Section, presided at a meeting held in Mellon Institute auditorium. Following a brief business meeting, four short talks were given. The talks were all designed to bring before the guidance counselors factual evidence of the existing opportunities in ceramic engineering and technology.

Scope of Ceramics

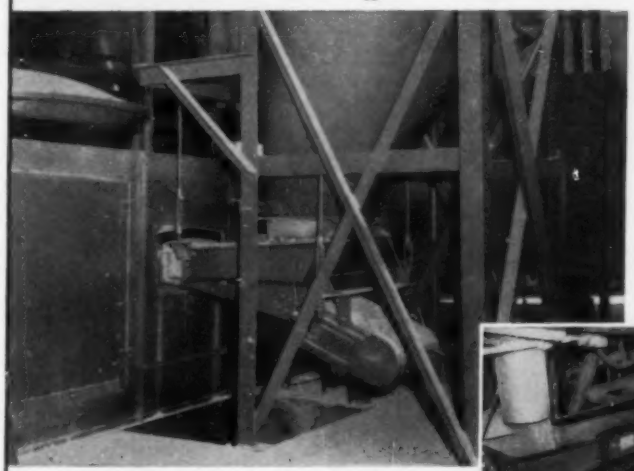
Dr. G. W. Brindley, head of the department of Ceramic Technology at Pennsylvania State University, spoke on such matters as the scope of ceramics, its industrial importance, recent new product developments, variety of work opportunities, and aptitudes needed. He concluded with information on schools, scholarships and salaries.

Raymond E. Birch, director of research for Harbison-Walker Refractories Co., presented the industrial viewpoint. Examples were cited to point out a trend in which an increasing number of industrial advances were seen to depend upon improvements or completely new developments in ceramics. This trend makes possible many interesting career possibilities in ceramics.

B. Parker Hess, an electrical engineer from Westinghouse Electric

Continued on page 77

SYNTRON "Vibra-Flow"
Vibratory Feeders



Feeding lump clay from storage to muller

Feeding material from ribbon blenders on to belt supplying lacon

add new economy and efficiency to your ceramic and brick production

SYNTRON Vibratory Feeders provide continuous handling of clay, grog, sand and other materials in ceramic and refractory plants all over the country. Combining positive vibration with instant control of flow, they move clay and other materials — hot or cold, damp or dry — smoothly from bins and hoppers to screens, conveyor belts, mullers and other process equipment. By maintaining positive control of materials flow any interruptions in the process cycle are eliminated.

SYNTRON Vibratory Feeders are built in a range of capacities with single, dual, twin and twin dual magnets—above or below deck mounting with tubular or flat pan troughs.

Years of experience in the materials handling field qualifies SYNTRON to act on your problems, both large and small.

Feeding grog, clay or sand onto belt that supplies mixer

Other SYNTRON Equipment

designed to increase production, cut production costs, improve products

Vibrators (bins, hoppers, chutes)	Rectifiers (Silicon and Selenium)
Vibratory Feeders	a-c to d-c Selenium Rectifier Units
Vibratory Screens	Electric Heating Panels
Shaker Conveyors	Electric Heating Elements
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Weigh Feeders	Shaft Seals
Packers and Jolters	Electric Hammers
Hopper Feeders	Concrete Vibrators
Lapping Machines	Paper Joggers

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Production Costs hit BOTTOM . . .

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A Varco steel building keeps production cost down by giving expensive equipment the kind of shelter and protection it must have in order to operate with lasting efficiency. It's good sense today. . . . It's good profit tomorrow to improve and modernize with low-cost Varco Buildings.

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STEEL BUILDINGS

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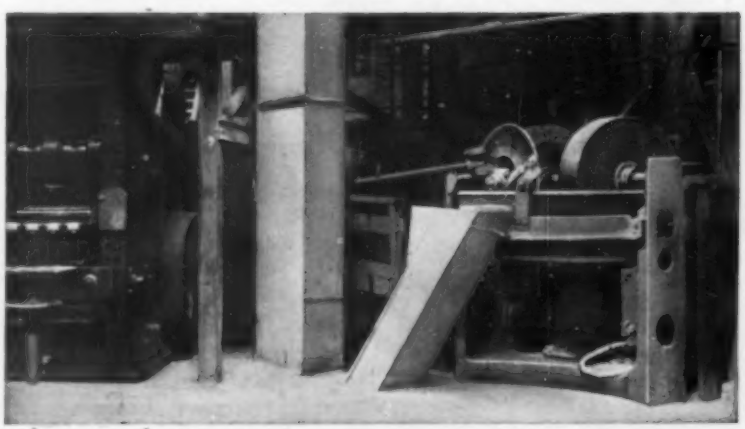
THE CLEARFIELD MIXER



No. 610 Clearfield preparing dry press material in fire brick plant.

Write today for Bulletin C-5 for complete information.

For Ceramic and Refractory Materials

In preparing clay materials for use in ceramic and refractory plants, the Clearfield Mixer with the revolving bottom is the most efficient and economical means of blending and tempering. Dry, semi-dry and high moisture content mixes are produced with thorough diffusion of all components of the batch. There is no segregation of larger or smaller parts. A uniform, even-textured clay mixture is produced with no lumps or voids. If you have a mixing problem, contact us for technical assistance.

CLEARFIELD MACHINE COMPANY

CLEARFIELD, PENNSYLVANIA

Pacific Coast Representative: Fernholtz Machinery Company, 8468 Melrose Place, Los Angeles 46, California

3rd Quarter Sales, Earnings Up at PacClay

Sales and earnings of Pacific Clay Products in the third quarter of 1958 exceeded by a substantial margin the results for the first two quarters of this year and for the comparable period of 1957, President John D. Fredericks announced in an interim report to shareholders.

For the three months ended September 30, 1958, sales totaled $2,893,277 and earnings amounted to $362,161, equal to 70 cents per share on the 516,434 shares of capital stock outstanding. In the first and second quarters of this year, sales were $1,875,541 and $2,583,792, respectively, and earnings amounted to 33 cents and 63 cents per share. For the third quarter a year ago, sales were $2,070,141 and earnings were $304,530 or 59¢ a share on the 516,158 shares then outstanding.

For the nine months ended September 30, 1958, net sales and other income totaled $7,352,610 compared with $6,600,238 for the same months of 1957. After all charges, net income in the first nine months of this year amounted to $859,687 equal to $1.66 per share on the 516,434 shares of capital stock outstanding. Net income for the corresponding months of 1957 totaled $975,973 or $1.89 on the 516,158 shares then outstanding.

C. J. Clippert Dies

Conrad J. Clippert, 62, vice president of the Clippert Brick Co. in Detroit, died Saturday, Sept. 27.

PENN. ACS Continued

Corp., had a long display table filled with many of his company's products in which ceramic parts are of prime importance, even though the company is not regarded as a ceramic manufacturer. It clearly demonstrated the importance of ceramics in the transmission and utilization of electricity, and in electronics.

The final talk was given by H. P. Bonebrake, vice president of the Aluminum Co. of America. He made brief reference to the antiquity of ceramic technology, and gave a few facts and figures emphasizing the greatly accelerated rate of advancement which has taken place in most recent years. One striking example was the improvement of aircraft spark plug porcelains during World War II and its importance in turning the tide toward victory in the air. The same improved spark plug porcelains now make possible the modern high compression automobile engine.

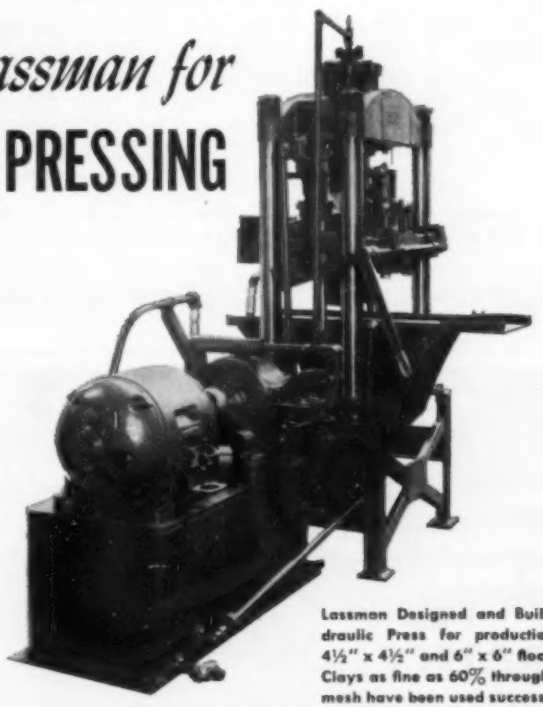
Opportunity was given for informal questioning after the meeting, and much interest was evident.

Each counselor was provided with a zippered plastic portfolio containing attractive illustrated brochures on career opportunities in ceramics, such as those published by the American Ceramic Society and the Refractories Institute, etc. A collection of pertinent publications from Penn State's department of ceramic technology was also included.

The meeting concluded in the club rooms where coffee and cookies were served, and further discussions continued.

it's Lassman for

DRY PRESSING



Lassman Designed and Built Hydraulic Press for production of 4½" x 4½" and 6" x 6" floor tile. Clays as fine as 60% through 200 mesh have been used successfully.

For over 25 years we have specialized in dry press forming of refractory brick and briquetting of granulated materials. From ¾" thick floor tile to 16" deep ladle nozzles, we are able to provide a product of commercially uniform density and free from entrapped air laminations. Our presses, hydraulically powered, assure you of flexible, smooth performance without leaks and with minimum maintenance.

We welcome the opportunity to discuss your dry pressing problems with you.

Quality EQUIPMENT for *Quality* PERFORMANCE

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BESSER Brickveyor

• The Besser Brickveyor is the modern way to position brick for the cubing operation. A brick cuber picks up 32 brick at a time and deposits them on Brickveyor in an upright position. Two variable speed belts automatically tip brick from vertical to horizontal position. Adjustable inclined gravity roller conveyor accumulates rows of brick for brick clamp handling at opposite end of Brickveyor. The brick clamp, interchangeable with block cubing clamp, assures fast, safe handling from Brickveyor to cube.

Brickmaking is profitable when you can make brick on a Vibrapac and cube them with the help of a Brickveyor. Handles up to 60,000 brick per day. Speeds up the job.

• Send for Bulletin No. 128 describing 4 ingenious ways of handling block or brick by power.

BESSER COMPANY • Complete Equipment for Concrete Block Plants • Alpena, Michigan, U. S. A.

A8-172½H

Tufhorse KANT-RIP MITTENS HAND PADS GLOVES

NO. 300

PROTECT WORKERS' HANDS!

**HEAVY SPLIT-COWHIDE MITTEN NO. 300.
$12.60 PER DOZEN PAIRS.**

Avoid costly injuries to the hands of your workers by giving them the protection they need—Tufhorse gloves, hand pads or mittens. Made of the finest cowhide, they are flexible and comfortable to wear.

ORDER SAMPLE PAIRS AT "PER-DOZEN" PRICES

Please send me samples of

☐ Glove No. G-9 ($16.50 per doz. pairs)
☐ Mitten No. 300 ($12.60 per doz. pairs)
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For Dependable, Steady Flow and Uniform Feeding...

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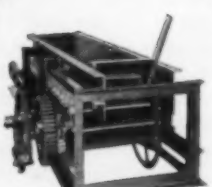
RECIPROCATING PLATE AND APRON FEEDERS



Whatever your material handling problem; shale, fire clay, coal or similar crushed coarse materials of any size, MECO can provide Feeders specifically designed to do the job.

MECO Reciprocating Plate and Apron Feeders are designed to provide dependable, steady flow of materials to crushers, grinders, dry pans, or other equipment, with a minimum of friction and power consumption; thereby reducing maintenance costs.

Write *today* for Bulletin #573 . . .

THE MANUFACTURERS EQUIPMENT COMPANY
218 MADEIRA AVE. • DAYTON 4, OHIO • Phone: BA 2-5565

plexity of the burning system was such that standby features would not be economical in the Canton area where curtailment orders are not frequent and, when only partial, the periodics could be sacrificed in favor of the tunnel.

Cars leaving the tunnel kiln move directly to the unloading station where the tile are graded under the high intensity illumination packed in separators and delivered to the shipping department.

Non-production departments at Stark include the machine shop, the automotive repair shop, electrical department, carpenter and plant maintenance supply department, traffic department, production control, sales and promotion as well as general administration.

Four employees in the machine shop use over 35 major pieces of equipment in the production of dies, jigs and repairs; in addition, doing the construction of special equipment needed by the operating department and which often is not available as commercial units. Practically any size of job can be handled in the plant shop. Automotive repair has charge of maintenance on almost 50 different pit or plant vehicles and machines, including 10 fork trucks used in plant for the movement of finished ware. Many of the plant units use LP gas instead of gasoline.

Incoming orders are handled by the sales department and then routed to the scheduling and traffic department where the new order is compared against the backlog and the production rates of the various types of ware. After the order is fitted into the schedule, production orders are issued covering it and the manufacturing divisions proceed to plan their production. The sales of Stark Ceramics are handled through a six-man department who supervise and control some 75 distributors scattered throughout the United States and Canada. Many of these agents have represented the company for over 40 years and are considered by the company to be an integral part of the organization.

Shipping Load Squeezer

Shipping glazed tile requires the highest order of care as the units are subject to chippage. The company has developed some unusual methods to reduce costly breakage. The full floating load is used to a great extent with the load of cardboard packed tile in each end of the rail car being compressed into the tightest possible packing with a motorized car squeezer that is run into the doorway of the car after the tile is loaded. The squeezer pushes the tile on each side of the door toward the respective ends of the car, after which a bulkhead is placed and steel strapping, previously placed under the load on the floor before the car was loaded, is brought around the load and secured. This method has met with good customer reaction as the expensive time-consuming breakage is reduced to a low average.

How Many Wadsworth Brick?

In the headline of the story on Wadsworth Brick & Tile in the October issue, our editors inadvertently said the potential capacity of this plant is "6 Million Brick A Day." This, one of those unexplainable oversights, obviously should have said, "6 Million Brick A Month."

Proving the readership of B&CR, we were swamped with phone calls and letters from readers, saying in effect, "*How many* brick a day?"

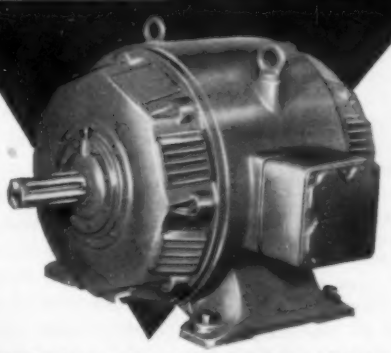
Dallas LW Income Up in Quarter

Dallas (Tex.) Lightweight Aggregate Co. had net income of $38,863, or 34¢ per share, for the three months ended Aug. 31, according to Ralph B. Rogers, president.

This compares with net income of $24,814 or 22¢ for the similar 1957 period. Dallas is a subsidiary of Texas Industries, Inc.

Sales for the 1958 period were 169,574, compared with the 1957 figures of $150,520, Rogers said.

A 125 H.P. Brook A.C. Motor Is *NOT* *Almost* 125 H.P.



When you purchase a Brook Motor of a given horsepower, that is just what you get. You need not buy 150 H.P. to make sure you get the 125 you require. Every Brook Motor has ample "copper" to deliver the particular horsepower involved — every Brook Motor is dynamically brake tested. You just cannot buy a better motor — yet, Brook Motors cost up to 20% less than ordinary electric motors. Get the facts — send for literature. Standard frame and new NEMA Rerate frames. 1 to 600 H.P. Warehouses and Service Centers in major cities.

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BROOK MOTOR CORPORATION

MOTO-BUG performance report:

Solves a clay products company's needs for a light-weight fork lift with 1000-lb. capacity

Wanted: a fork lift light enough in weight, yet big enough in capacity to lift and safely carry 1000 lbs. over weight-restricted floors. That was the problem facing a western clay products company. They tried a low-cost Kwik-Mix® S-10 Moto-Bug® — liked it — *bought it!* Equipped with special forks to handle various sizes of pipe in single or multiple loads, their S-10 transports green sewer pipe from press to the drying room — is shown above carrying a large-diameter 950-lb. pipe.

"Doing a good job for us"

Commenting on Moto-Bug's dependable performance, superintendent for the company reports, "We feel that this machine is doing a good job for us . . . it has worked well, and is the answer we needed to our problem."

Other uses

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New Report on Rocket Refractories

A report which reviews the state of the art (to 1955) of development of high-temperature refractories for use by the Naval Ordnane Test Station. The volume is available from the Office of Technical Services, U. S. Department of Commerce.

Prepared for the guidance of the novice in the field of rocketry as well as the experienced engineer, the report brings togther scattered literature on refractories appearing to 1955. It sets forth required characteristics of acceptable rocket refractories. Basic refractory substances, including metal oxides, metal-metalloid compounds, and intermetallic compounds, are also discussed, both individually and as ingredients of bonded-ceramic and cermet compositions.

Practices then current for the use of refractories as protective coatings, combustion chamber liners, and nozzles are reviewed, with special emphasis on commercial materials. Design and fabrication are discussed, and physical and chemical properties, manufacturers and products are listed. The volume also points out areas for future research.

The report, PB 131502, Rocket Refractories, H. B. Porter, Naval Ordnance Test Station, Aug. 1955, may be ordered from OTS, U. S. Dept. of Commerce, Washington 25. It contains 55 pages, price $1.50.

BEDFORD Continued

gestions from users in the field, were used to develop the authors' recommendations.

The National Bureau of Standards was also represented by W. L. Pendergast, who reported on the development of a testing device to simulate the exposure of pavement to jet aircraft exhaust and preliminary work with jet blast resistant concretes. The testing device greatly accelerated the testing of concretes. Pendergast reported that the type of aggregate as well as the curing program affected jet blast resistance.

"Instrumentation and Control Techniques as Applied to the Refractory Industry" was the title of a paper presented by John Puckett, Jr., of Leeds & Northrup.

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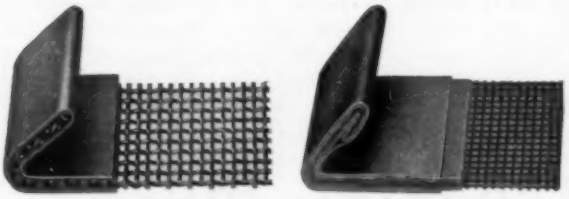

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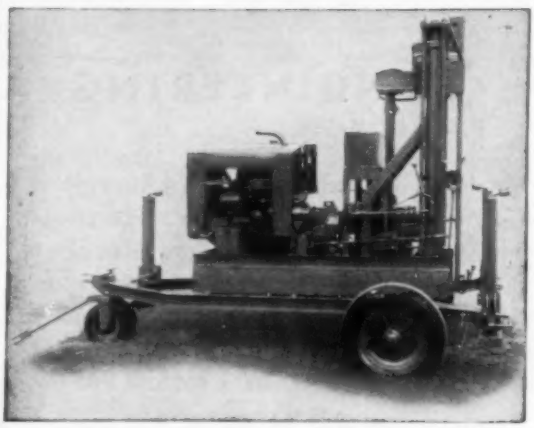

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Stran-Steel Names Seven to New Posts

Charles Le B. Homer, president, Stran-Steel Corp., a division of National Steel, announced the appointment of C. V. Blackburn to the position of executive vice president, and six other men to top posts in the corporation.

Blackburn has been vice president, sales. He came to Stran-Steel in 1956 from General Electric Co., where he was sales manager, consumer products, construction materials division.

Julius G. Skaaren, formerly manager of building sales, was named general sales manager. George R. Thomas replaces Skaaren as manager of building sales.

Max Luft was named marketing services manager. He was formerly manager of customer service and is replaced in that capacity by Lamar Heine.

Robert R. Scrase has been named executive assistant to the executive vice president.

John H. Murphy, formerly with Ford Motor Co., is manager of the newly created product planning and coordinating department.

Henry Robinson, assistant production superintendent of Robinson Clay Product Co., is being transferred from Akron to Pottstown, Pa. The transfer is being made to expedite production control and supervision in the Clearfield and Pottstown plants of Robinson, the announcement said.

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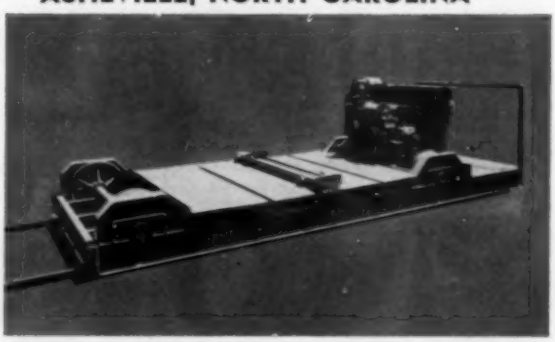

Represented By: **Forrest A. Paschal**
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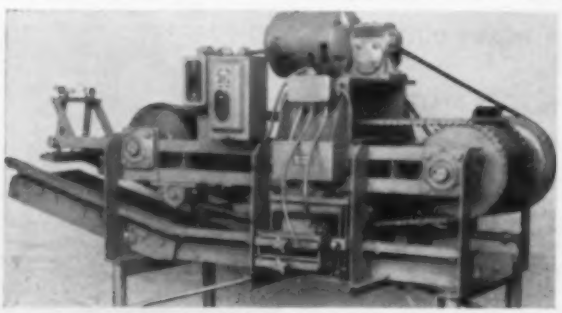

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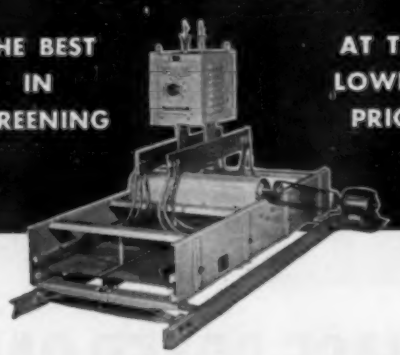

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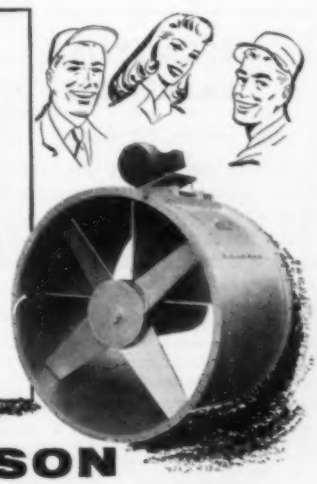

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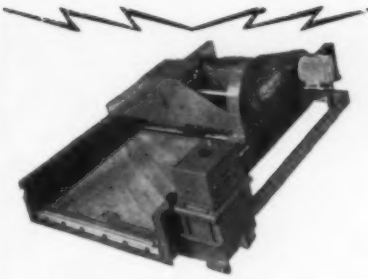

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Heated Screens for Utmost Efficiency

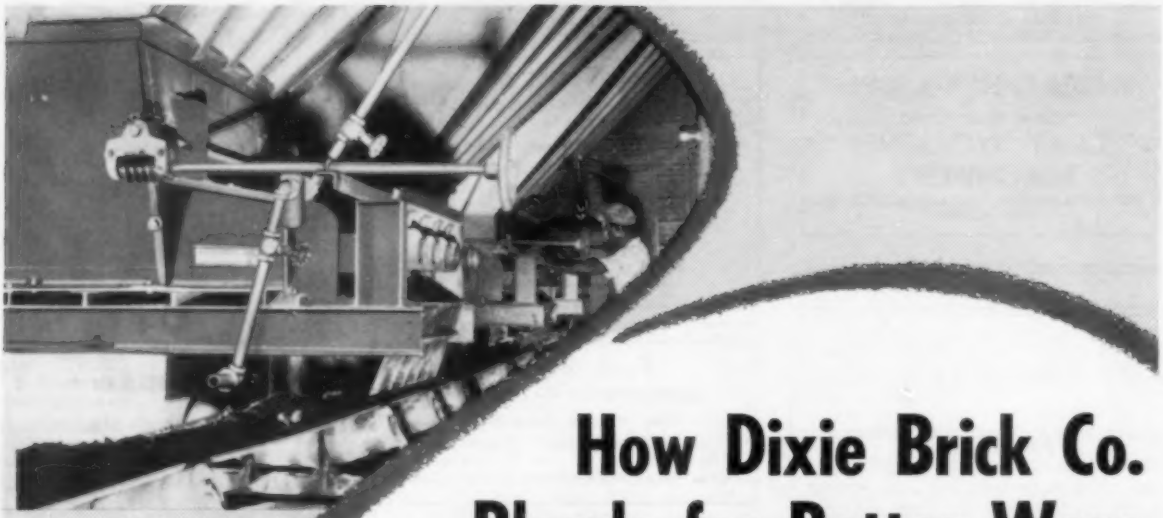
Whether your needs are for a small screen or for many in battery, you can have top screening efficiency with the Leahy heated screen. Made in a dozen standard sizes, ranging from screen jackets of eight square feet to forty square feet in area, there is virtually no difference in ability to deliver accurately sized screened products at full screen capacity — and on long non-stop schedules.

Aiding the efficiency of differential vibration is another exclusive feature . . . the short runs of laminated oversize bus bars that completely eliminate bothersome flexible connectors while reducing electrical resistance between the transformer and the heated jacket.

For full information about how the Leahy Screen can step up your plant efficiency, send for Bulletin 16-EH.

THE Leahy NO-BLIND VIBRATING SCREEN
— offers —
INTEGRATED HEAT SCREENING

THE DEISTER CONCENTRATOR COMPANY
The Original Deister Co., Est. 1906
913 GLASGOW AVE. FORT WAYNE, IND.



Battery of 3 Steele No. 88C Even Feeders at the plant of Dixie Brick Co.

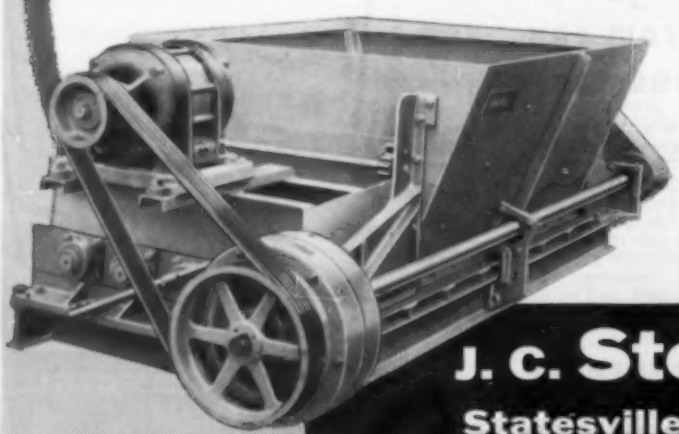
How Dixie Brick Co. Blends for Better Ware

. . . with Steele No. 88C Even Feeders

This battery of three Steele Even Feeders is used to blend three different type soft surface clays, but can be used on any type materials. The blend discharges on a conveyor belt and goes through the disintegrator and smooth roll crushers and then on to the pugmill. They can be used singly, two at a time, as well as a battery of three.

The 88C produces materials at the exact rate desired; screened and dry in some and soft and wet in others, up to about 80T/Hr. Bins can be made large enough for considerable storage clays and shales. Big hoppers, steep sides and the positive force of the spiral shafts prevents arching, choking, gorging, and starving.

Steele Feeders are also available in the smaller 44C and the larger Double 88C sizes. We will be glad to give you full information on these machines.



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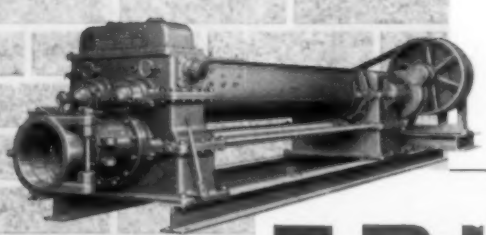
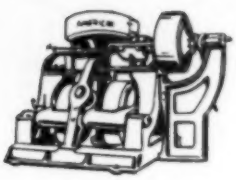


F·R·H Ceramic Machinery

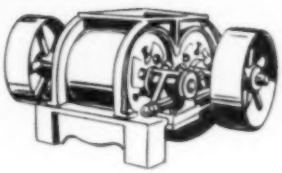
The FATE-ROOT-HEATH Company
Dept. B-1, Plymouth, Ohio

FROM PIT TO KILN . . .

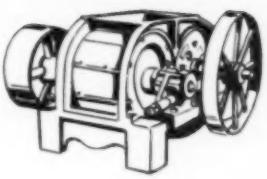
CLAY PRODUCTION MEN CHOOSE *American*



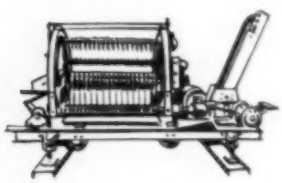
GRINDERS



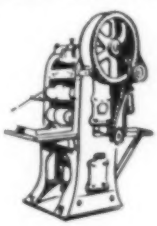
SMOOTH ROLL CRUSHERS



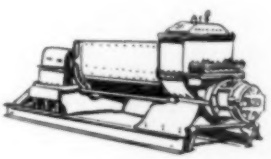
DISINTEGRATORS



ELECTRIC CUTTERS



REPRESSES



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